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ABSTRACT

Part of the National Park Service "Parks as Classrooms" heritage education program, this educational outreach curriculum was designed for a wide range of grade levels to use the resources available at Grant-Kohrs Ranch National Historic Site (Montana). The curriculum subjects include cultural heritage education and environmental education. The curriculum's teacher guide provides background information for classroom preparation, ideas for on-site activities, and follow-up study for post-visit activities. The curriculum contains a video to prepare for the class visit and to help the teacher decide which activities are best suited for the subject matter being studied. The following sections begin the curriculum guide's "table of contents": To the Teacher; Program Description; Logistics; Area Map and Information; and Group Reservation Form. The guide then offers section 1, "Life on the Range: The Frontier Cattle Era," and section 2, "Cottonwood Creek Nature Trail." Appendix A contains extension cowboy culture activities, while Appendix B contains extensive nature trail activities. A Program Evaluation section is attached. (BT)

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"HISTORY, NATURALLY!"



A Teacher's Guide



An educational outreach program for Grant-Kohrs Ranch National Historic Site Deer Lodge, Montana

SO 031 217

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NATIONAL PARK SERVICE
Grant-Kohrs Ranch National Historic Site
P. O. Box 790
Deer Lodge, Montana 59722

IN REPLY REFER TO:

NOTE TO SCHOOLS REQUESTING
"HISTORY, NATURALLY!" OUTREACH MATERIALS:

We are pleased you have asked for the outreach program materials for your class, and hope that you will be planning a site visit to further enhance your students' learning experience. If you have already scheduled a date to come to the ranch, then we'll be looking forward to seeing you soon! However, if your visit is more than 1 month away, we would like for you to copy the text needed from the teacher's guide, and return the guide and video by the date below (rtn'd.) to Grant-Kohrs Ranch NHS. This is so that we may mail it to other schools requesting the package.

When making copies prior to your site visit, please be sure to include the evaluation form. After your site visit, you can turn in this form to the rangers at the ranch, or mail it in upon your return to school.

If you have not reserved a date for visiting the ranch and would like to do so, return the completed reservation form along with the guide book and video after copying any materials, so that we may enter your school's date on our master calendar. Please include an alternate date, just in case.

If your school is unable to schedule a trip to the ranch site, you may keep the guide book and video up to 1 month. A suggested return date is printed below (rtn'd.). Please fill in and return the evaluation form as it pertains to your class use of the materials. Please rewind the video prior to returning it to us.

To return mail the package, simply reverse the mailing label so that the ranch address shows along with the stamps, and secure with a plastic tie (included in the front of the binder). Also, put one tie through the zipper and lock. Pull both ties tight and trim the excess.

Thank you for your interest in the "HISTORY, NATURALLY!" educational outreach program. Your comments and suggestions are appreciated and helpful in improving this project!

Sincerely,

Wil Stalker

Park Ranger, Interpretation
Grant-Kohrs Ranch National Historic Site

Soc. Studies Dev. Center	9-30-95	9-30	10-30	8	NA	Bill
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Acknowledgements

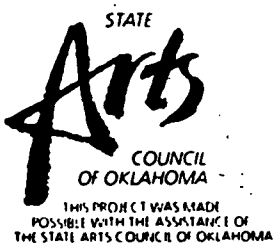
This curriculum-based program was developed by staff from Grant-Kohrs Ranch National Historic Site, Deer Lodge, MT. Special thanks go to the **National Park Foundation** for a grant which made this educational outreach entirely possible.

"Life on The Range" is reprinted with permission of the Oklahoma Foundation for the Humanities and the Oklahoma Museums Association from "The Cowboy: Myth and Reality" copyright 1991. This is drawn from the materials of "The Oklahoma Museum Education Project," which was funded in part by the National Endowment for the Humanities, the Phillips Petroleum Foundation, Inc., the Robert S. and Grace B. Kerr Foundation, the Kirkpatrick Foundation, and the State Arts Council of Oklahoma.

Text for the Cottonwood Creek Trail section was compiled and adapted from the following sources: National Wildlife Federation, copyright 1972, and Minnesota Environmental Sciences Foundation, Inc. for the environmental activities; Oregon State University "Sea Grant College Program", and Oregon Department of Education for additional units of environmental education.

We gratefully acknowledge these sources of educational information for allowing the use of their materials in the production of this guide.

"History, Naturally!" is part of the National Park Service "Parks As Classrooms" heritage education program.



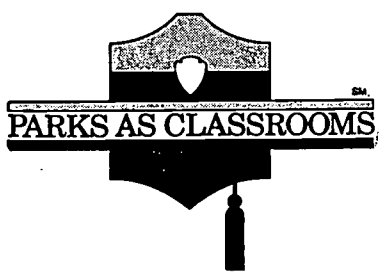














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TO THE TEACHER

Thank you for arranging your group's visit to Grant-Kohrs Ranch National Historic Site. We are pleased you are taking the opportunity to use the Site resources to enhance the classroom learning experience. This guide is designed to prepare you for your visit, and provide additional learning opportunities for use in the classroom following the site visit.

This guide contains two main sections, one dealing with the open-range cattle era and cowboy life, and the other describing the unique environment surrounding a small creek on the ranch. Within these two sections are subsections which provide background information, classroom prep activities, on-site projects and extension activities after return to the classroom. You will want to read the **LOGISTICS** section prior to the site visit, as well as viewing the enclosed **VIDEO** with your class.

A **THEME** statement and **OBJECTIVES** are located in the **BACKGROUND INFORMATION** in each section. The site program and curriculum materials are theme-related, and designed to help students achieve the stated objectives. The objectives represent basic levels of understanding that can be built upon to accommodate individual group needs. We ask that you refer to this part when evaluating the program at the conclusion of your visit.

BACKGROUND INFORMATION is for your use. The content is specific to the theme of your program, and should be presented to the class prior to your visit. This information can be incorporated into any of the pre and post-site visit activities.

Each of the pre- and post-site visit activities corresponds to a specific portion of the on-site experience. Pre-visit activities should be used to prepare students for the site visit. Some of the pre-visit lessons can be performed on site, so you will need to review them and determine which would be appropriate for the class objectives. Post-visit activities are designed to reinforce the site experience and provide extension opportunities for further study. Some of the lessons can be copied directly for student use, others need to be directed by the teacher.

There is a **RESOURCE** section within each main section. This will provide you and the students with additional reading and source material for background or extended study. The **APPENDIX** contains additional activities for both cultural and natural history lessons. These can be adapted for most grade levels, and provide ideas for site activities and extended study.

Finally, there is an **EVALUATION** form in the back of the guide. Please take time to complete and return the form with the teacher's guidebook. Your feedback is greatly appreciated, and this will help assure our curriculum and program are serving the needs of educators and students.

We look forward to seeing you soon!

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PROGRAM DESCRIPTION

The **"History, Naturally!"** educational outreach program was designed for a wide range of grade levels to use the resources available at Grant-Kohrs Ranch National Historic Site. The subjects include cultural heritage education and environmental education. The teacher's guide provides background information for classroom preparation, ideas for on-site activities, and follow-up study for post-visit activities.

The on-site experience is decided beforehand by the class and teacher. The activities are designed so the teacher, chaperones and students are self-sufficient during their visit. Due to scheduling and staffing constraints, there will be minimal contact with Park Rangers, unless specifically requested for a cultural demonstration.

After having prepared the class for their visit by viewing the video, you will decide which activities are best suited for the subject matter being studied. Upon arrival at the ranch, you will be greeted by a Park Ranger at the Visitor Center and given directions to either the ranch or nature trail. From that point on, what you get out of your site visit is up to you.

Most activities will require about 2 hours, from time of arrival, walking to the site, set up, presentation, conclusion to departure.

LOGISTICS

- Groups enter the main gate, and check in at the Visitor Center. From here, they walk 3 blocks to the ranch, or 2 blocks to the nature trail entrance. Dress appropriately; all activities are conducted outside.

- If groups are using the nature trail, they may check out 'Discovery Paks' (1 for every 5 students) to use for trail activities. Each Pak will be inventoried upon return to the Visitor Center.

- If groups are using the cowboy costume or other props, you will need to request the trunk be placed on the porch of the main house; instructions are inside. Most heritage history lessons will either be conducted on the front lawn of the house, or in the lower ranch yard behind the house (see area map).

- The teacher and chaperones [1 per 10 students] will maintain order and behavior of the group at all times. There will be other visitors on the ranch at the same time as your group, so please be courteous and respectful.

- The teacher may copy materials in the guidebook in order to complete extension activities after returning to school. The guidebook, evaluation form and video should be returned to the Visitor Center at the conclusion of your site visit.

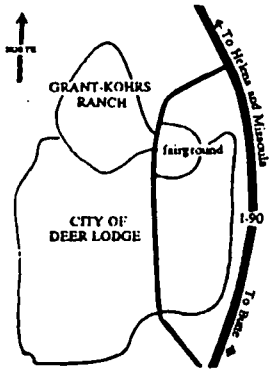
If there are any questions about the contents of this book or regarding your ranch visit, please call or write:

Grant-Kohrs Ranch National Historic Site
P.O. Box 790,
Deer Lodge, Montana 59722
(406) 846-2070

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AREA MAP AND INFORMATION

Grant-Kohrs Ranch National Historic Site was established to commemorate the Frontier Cattle Era: the days of the open range, trail drives and roundups. In addition to the historic aspect of the ranch, there is a nature trail available for groups to study a creek-side environment.



The main ranch parking area and visitor center are less than a mile off I-90, at the north edge of Deer Lodge, Montana. The ranch is midway between Glacier and Yellowstone National Parks.

Things You Need To Know - To assist you in planning your class visit to the site, please read the following:

Chaperones - School groups must be chaperoned for the safety of the students, artifacts and livestock. Please arrange for at least 1 alert adult for each 10 students. Control is important inside the house, around the barns and on the nature trail.

On-Site Activities - The purpose of the guidebook and activities is so the teacher and students can be "self-sufficient" during their ranch visit. This means that a Park Ranger will not be with your group. The teacher and students are responsible for their learning experience while here. Most of the supplies you will have to bring; the ranch has 1 trunk with cowboy clothing available by reservation only; there are 'Discovery Paks' at the Visitor Center which contain equipment and ideas for outdoor lessons. The Pak contents will be inventoried upon return to the VC. Any damaged or missing items will be replaced by the school group.

Facts To Consider - All activities are conducted outdoors. Students should be aware of and prepared for weather changes, which can occur on short notice. Long pants, sturdy shoes or boots, and long-sleeved shirts are recommended for the nature trail especially. There are ticks and mosquitoes near the creek. (Bug spray is provided in the Discovery Paks).

The walk from the parking area to the ranch is a paved path, 1/4 mile long. A wheelchair is available if needed; please ask for it on the reservation form. The walk to the trail entrance is about 1/8 mile on the same path. The trail surface is not paved, and can be uneven and wet in places.

Restrooms and drinking water are available at the entrance, and in the lower ranch yard behind the main house. DO NOT DRINK FROM THE CREEK OR RIVER.

There are no picnicking facilities on the ranch site. There is a city park with shaded tables 1/2 mile from the ranch. Please do not bring food items on the ranch site; the food and wrappers are harmful to the livestock, wildlife and the environment. Please use trash cans for all litter you find.

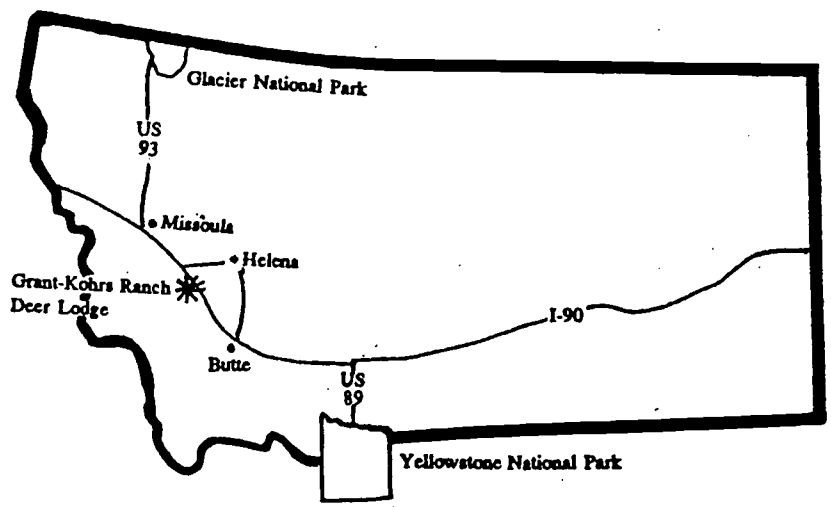
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Limited bus parking is available for groups conducting the cultural history lessons near the old ranch buildings; ask for directions when checking in at the Visitor Center. Nature trail users park in the main lot.

Reservations - Each group wanting to visit the ranch site and use either the nature trail or the historic ranch for lessons **must reserve** their trip date first. To do this, fill out the form and send to the address below. Please include an alternate date if possible. We will confirm your request either in writing or by phone. Reservations must be made at least 2 weeks in advance.

NOTE: most school groups visit the ranch in May and June and those dates fill quickly; you are encouraged to try early spring and fall dates i.e. September, early October and mid to late April are 'quiet' times. If you have any questions, please call or write us at:

Grant-Kohrs Ranch National Historic Site
P.O. Box 790, Deer Lodge, MT 59722
(406) 846-2070



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SITE VISIT RESERVATION FORM

Visit Date (1st choice)_____ 2nd choice_____

School Name_____

Address_____

_____

Telephone_____Teacher Name_____

Group Size_____Grade Level_____

Chaperones_____Arrival Time_____

Area of Study - Cultural/Cowboy History_____Nature Trail_____

We will need: Cowboy Clothing trunk_____ Discovery Paks_____. If you will be performing "Chuckwagon Cooking", check_____ (school is responsible for providing beans, paper cups, utensils, napkins, and clean-up of area). Occasionally, staffing allows us to provide additional interpretive presentations for school groups. These include blacksmithing, draft horse use, and brief house tours. If your group is studying history, we might be able to arrange for a special demonstration. Check if you would like:

Blacksmithing_____ Draft Horses_____ House Tour_____

Because the rangers providing these demonstrations have additional job duties, you will need to arrive at the ranch ON TIME.

My class is currently studying (subject)_____

We will be using the classroom preparation for the following activities:

_____

_____

_____

I understand I must return the guidebook, video and any other borrowed materials to the Visitor Center after the site visit.

Signed (Teacher Name)_____

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THE COWBOY

The most storied figure of the Old West was the Cowboy. He is shown here as Russell knew him best. He wears chaps, carries a Colt frontier model revolver and has his lariat loop out preparatory to choosing himself a mount.

The vignette pictures the Cowboy about to rope an N bar N longhorn steer.

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BACKGROUND INFORMATION

Life on the Range: The Frontier Cattle Era

Theme: The open range cattle era had a tremendous impact upon the development of the west, and brought about dramatic changes in the way people lived and worked in the late 1800's.

This section concentrates on the rise and fall of open range cattle ranching, and describes the life and livelihood of cowboys.

Objectives: After visiting the ranch and using activities in this guide, the students will be able to:

- List at least three 'jobs' cowboys did on the ranch.
- Describe pieces of clothing, gear and their specific use for a cowboy
- List 4 types of food a cowboy could eat on the range.
- Describe why the frontier cattle era ended, and when.
- Compare modern ranching practices with those of 1880.

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THE COWBOY

The most storied figure of the Old West was the Cowboy. He is shown here as Russell knew him best. He wears chaps, carries a Colt frontier model revolver and has his lariat loop out preparatory to choosing himself a mount.

The vignette pictures the Cowboy about to rope an N bar N longhorn steer.

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Cowboys and Ranching: An Overview

by
B. Byron Price

The seeds of ranching in the New World were planted in 1494 by Christopher Columbus, who deposited cattle and horses on the Caribbean island of Hispaniola. These early implants flourished and spread to other islands and finally, in 1521, to the mainland of what is now Mexico.

From a small contingent of livestock landed at Vera Cruz, cattle and horses multiplied rapidly and quickly spread throughout the central plain of New Spain and northward with the vanguard of Spanish settlement. Neither droughts nor Indian raids nor the colonists' appetite for beef checked the increase.

Of Andalusian and Castilian breeding, these bovines ranged widely, often drifting into remote and unsettled regions and growing to full maturity without encountering humans. Over several generations their domesticated European characteristics gave way to the gaunt, angular features associated with the wild and self-reliant longhorn.

The first cattle to reach the present-day United States arrived with the expedition of Francisco Vasquez de Coronado, who explored the American Southwest in search of gold and the fabled Seven Cities of Cibola in 1540-1541. Permanent settlements followed in 1598 when Juan de Onate occupied present New Mexico. During the colonial period, which lasted until 1821, ranching developed wherever Spaniards established missions, presidios and civil settlements. The most important and lasting implantations of cattle occurred in Texas, beginning in 1690 and in California in the 1760s.

During the seventeenth and eighteenth centuries, Hispanic stockmen perfected virtually all the major characteristics associated with the open range system of ranching, including roundups, branding, roping, cattle raisers' associations and long drives to market. Taxed heavily and subject to a labyrinth of governmental restrictions, Spanish ranchers also suffered from a dearth of commercial beef markets. Thus the raising of cattle was carried on largely as a subsistence enterprise, with hides and tallow overshadowing beef in value and importance in trade. Only for a brief period during the 1780s were export restrictions between the Spanish provinces of Louisiana and Texas lowered, creating a profitable beef export market. During these few years Spanish cattlemen from Texas drove sizeable numbers of beeves overland to New Orleans from the region around San Antonio.

Hispanic vaqueros, the herders upon whose labor the Spanish and Mexican cattle industry rested, occupied a special position within the Hispanic social hierarchy. Although their economic circumstances were comparable



A Sunfisher by Frederic Remington, 1895

to most common laborers of the period, their horsemanship and roping skills set them apart from other peasants who toiled on foot. Horses offered mobility and contributed to the romance, independent spirit and fierce pride which characterized these workers.

These attitudes also were reflected in the beauty and quality of the tools of the vaquero's trade. Such equipment as espuelas (spurs), rawhide and horsehair reatas (ropes), hierros fierros (branding irons), sillas vaqueras (stock saddles) and chaparreras (leather leggings), were not only utilitarian objects but also cultural icons, embodying religious, political, economic and aesthetic symbols in their design, construction and embellishment.

Many Americans migrating into Mexican Texas and California in the first half of the nineteenth century were familiar with Hispanic methods of rearing livestock, having previously encountered Spanish ranching enclaves in Florida, Alabama and Louisiana. Moreover, at least some of them had practiced a form of open range ranching complete with cowhunts, brandings and long drives to market in the southern pine barrens and midwestern prairies of the United States. Among these newcomers, however, ranching did not emerge with an identity separate from American- style stock farming until about 1850. During the interim Americans and European immigrants to Texas adopted or refined many Hispanic stock raising tools and traditions, added some of their own, and thereby laid the foundation for the rapid exploitation of commercial opportunities whenever they finally appeared.

The climate and grass of Texas offered stock raisers unprecedented opportunities to grow beef. As early as 1836, one resident reported that "cattle are spread all over the country, swarming like locusts, too numerous for calculation and are raised with less care and perplexity to the owners than chickens are in the north." Many settlers began to develop herds of hundreds and even thousands of head although Texas's remote location from the beef-consuming population centers of the eastern United States limited the economic usefulness of the prolific longhorns. Nevertheless, Texas stock raisers sold some to Federal troops and to local butchers and packing plants.

Behind cotton, beef hides were the state's most important export commodity. Merchants shipped thousands to Boston, Philadelphia and New York and to Europe where they were converted into shoe leather. Tallow, bones and horns also found a market and were transformed into candles, soap, fertilizer, combs and buttons.

Louisiana, especially the city of New Orleans, offered the most convenient and consistent outlet for the sale of Texas beef, driven overland or delivered by ship during the antebellum period. After the discovery of gold in California in 1849, however, stockmen found another market in supplying meat and draft animals for the vast overland migration westward from such outfitting centers as Kansas City and Saint Louis. During the early 1850s, a few enterprising Texas drovers delivered herds directly to California to feed hungry miners and settlers.

Meanwhile, midwestern cattle feeders also became interested in the cheap and plentiful longhorns, fattening their thin, bony bodies on corn before transporting them by rail and canal to urban eastern markets. Herds trailed from south of the Red River to Missouri and Illinois, however, bore a mysterious and deadly disease known as Texas or Spanish Fever. The ailment, carried by ticks, decimated herds along the northern droving routes and created such enmity among farmers in Kansas and Missouri that they formed vigilance committees and lobbied their state legislatures for quarantines against the afflicted stock.

The coming of the Civil War in 1861, however, overshadowed such concerns and closed off northern markets for Texas beef. A Union naval blockade severed commercial sea lanes and within two years Federal military operations had cut the Mississippi, denying stockmen their southern markets as well. Only a fledgling cattle trade with Mexico remained. While a few stockmen obtained exemptions and continued to pursue their occupations, most joined the military, leaving their herds at the mercy of thieves headquartered in Kansas and Mexico and the Plains Indians who bartered thousands to New Mexican traders, known as comancheros.

A severe drought throughout the Southwest during the war years further decimated the long-

horn population. Vast herds remained, however, and by the end of the war in 1865, a legion of largely unbranded animals roamed the ranges waiting to be claimed by returning Confederate soldiers.

The smoke of battle had barely cleared when unprecedented demand and soaring beef prices in the North revived the dormant Texas droving trade. At first, drovers returned to the Shawnee Trail and other traditional antebellum routes north through the eastern reaches of Indian Territory to Missouri and Illinois. In 1867, however, a railhead was extended to Abilene, Kansas, inaugurating the celebrated Chisholm Trail. By using the new route, which lay west of the general line of settlement, cattlemen avoided the objections of farmers concerned lest their crops and herds be destroyed by disease-bearing, passing herds.

The first of a series of Kansas "cow towns" to serve the droving trade, Abilene's notoriety outlived its usefulness as a shipping point. By the late-1870s Wichita, Newton, and Dodge City, Kansas, had surpassed Abilene in importance and the Great Western Trail had supplanted the Chisholm Trail as the principal beef thoroughfare from Texas.

In the three decades that followed the Civil War as many as ten million head of longhorns were trailed to market by shrewd contractors and professional droving crews. Fat beeves were forwarded to packeries in Chicago, Saint Louis and Kansas City while leaner animals found their way into the corn fields of the Midwest where they gorged for two to four months before entering the slaughterhouse.

Besides being an important factor in helping rescue Texas from the economic depths of postwar Reconstruction, the long drive became one of the most compelling romantic images in American mythology. The rowdy and sometimes bloody activities of cattle drovers celebrating at the end of the trail stood in violent contrast to the passive pastoral imagery usually associated with rural herding enterprises. Nevertheless, the epic movement of livestock north from Texas became a staple of western-inspired literature, motion pictures and television.

The rapid expansion of the cattle industry on the Great Plains during the 1870s and 1880s was abetted by the defeat of the native tribes of the region and their confinement to reservations. This process was accompanied by the wholesale destruction of vast herds of buffalo, freeing millions of acres of valuable grass as food for domestic livestock. While Texas remained the most important breeding ground for cattle, the ranges of the central and northern plains assumed the important role as finishing ranges. Many ranchers acquired pasture in both locations, taking advantage of government beef contracts awarded to supply soldiers and Indian reservations from the Dakotas to Indian Territory.

Coincident with the expansion of the droving trade came a boom in economic investment in ranching. Fueled by surplus capital and the promise of fantastic profits, eastern and foreign investors quickly transformed the cattle business from a largely individual enterprise into a hotbed of corporate activity by 1880.

The exotic and adventuresome promise of ranch life attracted the attention of countless boys and young men, of nearly every ethnic and social background— from eastern-bred Ivy League dudes like Theodore Roosevelt to European royalty to former black slaves. In some regions Native Americans managed cattle herds where buffalo once roamed.

On the largely "free grass" of the public domain, cowboys conducted their age-old, seasonal rituals of roundup, branding and droving under the quasi-legal authority and regulation of range custom and livestock associations. For months at a time these predominately batchelor cattle herders ranged far from the amenities of "civilization." Their social and cultural life centered around the chuck wagon: a home of sorts, a place to eat and sleep and socialize with fellow workers.

Whatever their origin, the cowboys of the West developed a warm comradary. A wealth of music and folklore emerged from their activities and observations and, moved by the often rich memories of their youths, many later wrote autobiographies (perhaps more than any other comparable class of laborers).

As the cattle industry extended over the plains and herds multiplied faster than consumption, attractive ranges became increasingly scarce. Stimulated by nearly two decades of strong prices and

high profits, some cattle companies, by the early 1880s, were paying huge dividends, some as much as 25 to 35 per cent a year.

After a few more boom years, however, the cattle industry began to suffer from its excesses. Crowded ranges became overgrazed and cattle prices declined sharply due to oversupply. A series of disasterous winters storms and summer droughts during the mid-1880s decimated herds and hastened the collapse of the open range style of ranching. Many companies failed altogether and all suffered an extended period of depression.

By the turn of the century, however, the cattle industry had emerged from the economic doldrums, more diversified and organized than before and operating on a more limited scale than during the open range era. This new order radically altered the cowboy's working environment.

Already many prudent ranchers had instituted policies prohibiting gambling, alcohol and sidearms on the job. Barbed wire fencing, manufactured since the 1870s, became more widespread, confining herds to definite ranges and significantly reducing the cowboy labor force. New railroad lines brought shipping points ever closer to sources of supply and, coupled with wire enclosures and the continuing controversy over tick fever, helped bring trail driving to a close.

Cowboy life after the coming of barbed wire required a broader range of skills than just roping and riding. On most twentieth century ranches, windmill repair, reservoir construction and crop cultivation joined cow work as an integral part of the daily routine.

The advance of agricultural settlement on the Great Plains and the subsequent rise in land prices signaled the breakup of large ranches in all but the most inhospitable regions. Smaller, crop-oriented stock farms replaced them. The new breed of ranchers began to invest more heavily in pure-bred Hereford, Angus and Brahman cattle, gradually replacing the colorful longhorn.

After the turn-of-the-century, science and technology also began to exert a profound influence on the cattle business. Vaccines were developed to control black-leg and other deadly stock diseases. In 1889 the Bureau of Animal Industry identified ticks as the carrier of the long-dreaded Texas Fever. A national quarantine law governing the movement of cattle was enacted and dipping vats containing a chemical solution fatal to ticks appeared on infected ranges. The battle against ticks lasted several decades.

The advent of the twentieth century brought other changes as well. Automobiles, along with paved roads, began to offer ranchers and cowboys greater mobility and social opportunity. Married cowboys became more common.

Trucks and other motor vehicles also revolutionized the cowboy's workplace, eventually replacing chuck wagons and freight wagons and supplanting railroads as livestock haulers. In like manner the coming of telephones, radios and electricity improved communication and the quality of ranch life.

After a brief period of widespread prosperity and high beef prices during World War I, the cattle business was dealt a severe blow by the Great Depression. Many ranches did not survive the dust and despair and many cowboys joined the rolls of the unemployed as a consequence. Although Federal agricultural programs enacted during the 1930s eventually stablized the cattle industry, many individualistic and independent ranchers expressed discontent with governmental regulation.

World War II breathed new life into the stalled beef industry. The second global conflict, however, produced shortages of both transportation and labor. To compensate, hard-pressed ranchers divided their range into ever smaller pastures with cross fencing and erected additional pens and corrals at strategic points to shorten the distance of drives and to decrease manpower requirements during roundups. They also relied more heavily on mechanical squeeze chutes and branding tables, labor saving tools which also were considered more sanitary and humane than the traditional methods of roping and dragging animals to the branding fire. During the war years women and children assumed greater responsibilities in the management of herds as well.

Ranchers could not, however, offset the effects of high urban employment and wages buoyed by prosperous post war economic conditions. When many former cowboys did not return to their old

occupations, managers increasingly depended upon the mobility of pickups and horse trailers to take up the slack. By the late 1950s the practice had became nearly universal.

The social implications of post-World War II urbanization produced even more profound effects. In order to counteract the lure of the cities and towns and to retain quality employees and their families, ranchers dramatically improved living and working conditions and wages. Nevertheless, a shortage of full-time hands persisted. Modern ranches rely upon the help of family, day labor and cooperative neighbors to conduct their cattle work.

Other trends set in motion in the 1940s continue, with the rate and course of future development largely dependant upon profitability and the complex interplay of the global economy, including such factors as tax laws, environmental regulations, import and export policies, consumer demand, interest rates, and credit. Certainly science and technology will continue to play important roles as will the demands of nutrition. Future innovations may include automated animal identification systems, hair dye forms of branding and chemical castration among others.

Whatever its future course, ranching remains rooted in rich and vibrant traditions that are manifest daily throughout American society— in music, literature, advertising and clothing and in personal attitudes and relationships. A mythology spawned by the cowboy lifestyle still helps define Americans as a people, both who we are and who we aspire to be.

The Cowboy Myth

By the time historian Frederick Jackson Turner developed his famous essay postulating the significance of the frontier to the development of American democracy, mourners had already gathered to lament the passing of the Old West and with it the free-spirited open range cowboy. The frequent and often eloquent eulogies that littered turn-of-the-century literature stood in stunning counterpoint to earlier depictions of cowboys as crude and unsavory ruffians, with few, if any, redeeming qualities.

Even before barbed wire brought an end to the open range, Buffalo Bill Cody began to reclaim and reform the image of the cowboy. Cody's version was a handsome, rugged, yet pristine likeness that American and Europe audiences adored. Cody billed one of his stars, Buck Taylor, a former Texas ranch hand, as the first, "King of the Cowboys," thereby elevating an anonymous group of $30 a month laborers to the status of royalty. It was the essence of the great American dream and Cody's show drew huge and enthusiastic crowds.

Following close behind Cody and his imitators, eastern-bred writer Owen Wister further refined the cowboy's heroic image, infusing it with Anglo-Saxon virtue and Southern chivalry in his landmark novel *The Virginian*. Wister's sometime collaborator, Frederic S. Remington (1861-1909) also was fascinated with the "wild riders of the plains." During a brief but brillant career as an illustrator, easel painter and sculptor, Remington won wide acclaim for capturing the cowboy spirit on canvas and in bronze in such works as "The Last Cavalier," "Dash for Timber," "The Quarrel," "In from the Night Herd," "Coming Through the Rye," and the "Bronco Buster." His work inspired generations of artists and illustrators, who created thousands of paintings and sculptures featuring western subjects, real and imagined.

Among those artists who felt Remington's influence was St. Louis-born Charles M. Russell (1864-1926). As a teenager, Russell joined a roundup crew in Montana as a horse wrangler and experienced cowboy life first-hand before taking up art as a profession. Russell's subsequent paintings and sculptures were often narrative, based on his own experiences or those of his fellow cowpunchers. Like many western artists of his generation, Russell sought to preserve the vanishing lifestyle of the open range cowboy. Contemporary western art continues to feel the impact of this self-taught artistic genius.

While Charlie Russell was translating personal experience to canvas, folklorists like John Lomax were collecting and publishing the authentic songs and stories of the cow camp. Within a few years, the disciples of Frederick Jackson Turner in academia, too, were producing a steady stream of historical studies based on western themes. The published recollections of real cowboys lent authenticity to many of these inquiries and thereby added a veneer of reality to the mythical cowboy hero.

Early in the twentieth century, dramatic and documentary western motion pictures also became a cinematic staple. Such early stars as William S. Hart, who made every effort to look and act authentically, passed the torch to strong, if more verbal types, like Tom Mix. Mix, who possessed a genuine cowboy background, added a measure of style and sophistication to the cowboy image, while retaining the basic heroic qualities that movie goers came to expect. In the four decades following the popular and critical success of the motion picture "Stagecoach" in 1939, John Wayne carefully defined the screen cowboy and made the character his own.

Singing cowboys like Gene Autry and Roy Rogers joined "Duke" Wayne as matinee idols, later making the transition to television, where cowboy heroes entered the living rooms of America several times weekly during the 1950s and early 1960s.

Even before the advent of television, however, millions of pulp magazines and comic books, many of them featuring cowboy themes, had been eagerly consumed by the reading public. Offering, "big, clean stories of outdoor life," the pulps packaged adventure and romance against a western backdrop in an unbeatable formula. In female-oriented versions like the popular *Ranch Romances*, cowboys replaced knights in fairy tales of the range. Such stories not only allowed women to participate in the cowboy myth but also permitted them act heroically on occasion. By wearing western clothes, attending rodeos, vacationing at dude ranches and furnishing their homes with western icons from lamps to dishes, people from all backgrounds became part of the cowboy myth.

Historian William Savage has pointed out in a seminal study, *The Cowboy Hero,* that for nearly a century the cowboy image has served two basic purposes in American culture: to define and transmit social values (particularly relating to masculinity) and to sell products. Savage has suggested that Americans readily embrace western imagery in times of distress and out of a deep longing to rediscover the basic values that guide their lives. He interprets the "Urban Cowboy" phenomenon of the late 1970s, for example, as the natural reaction of a country bewildered by failure in Vietnam.

Today the media is still replete with examples of the cowboy motif representing everything from cologne to foreign policy. The popularity of the Star Wars movie trilogy (a futuristic western where intergalactic gunfighters ride space ships rather than horses and wear ray guns rather than Colt .45s) and such recent traditional western films as *Dances With Wolves* and *Young Guns,* along with Larry McMurtry's Pulitzer Prize winning *Lonesome Dove* demonstrate the resilience and timelessness of western themes and the cowboy myth.

Cowboy Clothing and Equipment

Cowboys travelled light, sometimes with little more than the clothes they stood up in. Contrary to popular image, many cowboys did not own the horses they rode. These were provided by the cattleman who hired the cowboy for ranch work, for a round-up or for a trail drive. In a day of working cattle, each cowboy might change horses several times so that no one animal became exhausted. (It was the custom, however, that when a string of horses was assigned to a particular cowboy, no one could ride one of "his" mounts without his permission, not even the owner.)

The cowboy usually did own his saddle, and this often was his most expensive and most prized possession. A good, hand-made saddle could cost as much as three months' pay, but since a cowhand might spend 18 or more hours per day on horseback this was considered a good investment. To say a cowboy had "hung up his saddle" meant that he had retired from cowboying (usually because of age or injuries) or even that he had died.

As for clothing, it was chosen for service and for comfort. A long-sleeved cotton or wool shirt and sturdy workmen's pants were the basics. (Levi's or jeans were available and were popular, but they were brown instead of blue.) Much, if not all, of a cowboy's gear was borrowed and adapted from the Spanish vaqueros who introduced cattle to this continent and from their Mexican descendants who brought cattle into Texas. A hat with a broad brim protected the wearer from the sun or rain and could be used as a water dipper as well. A large bandanna served any number of purposes: it could be worn so that it protected the back of the neck from the sun; it could be pulled up over the face to filter dust; it could be tied over the ears in cold weather or used to tie on one's hat in the wind; it could be used to strain insects and tadpoles from one's drinking water. Leather boots protected the feet and ankles. The typical narrow toe enabled them to slip easily into the stirrups, and high heels held them from sliding too far forward. Bad weather gear included a warm jacket and a long rain slicker, split up the back so that it would drape over his saddle and the horse's flanks.



Additional garb served particular functions. Leather leggings, called chaparreras or chaps, were worn in rough country to keep the legs from being scratched in the brush. In colder climates, the chaps might be covered with fur or wool for extra warmth. Spurs were used to guide one's horse, but these might range from a plain, functional model to elaborately engraved silver. Danglers and heel chains on some models produced a pleasant jingle as the cowboy walked down the wooden sidewalks of the cowtowns. (Some cowboys not only jingled as they walked, but also perfected a gait that allowed them to spin the rowels of their spurs with each step!)

Branding Cattle (An Incident In Ranch Life) by Frederic Remington, 1888

Most cowboys also wore a holster and pistol, although they generally were not the sharpshooters that the fictional cowboys have led us to expect. The guns were used for hunting, for protection, or even as a means of communication. (For example, three shots, evenly spaced, were understood as a signal for help.)

While being an expert shot was not required in a cowboy's day to day work, riding and roping skills were very important. The earliest catch ropes, called reatas, were made of rawhide, but fiber lassos of manila hemp, manufactured in the East, became more widely used because they were both stronger and cheaper.

The migrant cowboy's final piece of equipment was his bedroll. This was a canvas covered quilt or comforter that could be rolled up and stored in the chuck wagon or behind a saddle. It served not only as a mattress, but also as a clothes press and duffle bag. An extra shirt, clean socks and underwear and small personal items were rolled inside for easy transporting. Ramon Adams, in *The Old-Time Cowhand*, says, "Lookin' into a cowboy's bed was like visitin' a clothin' store, a hardware store, and a saddle shop, all in one."

Activities

Cowboy Bingo and ***Auction:*** These two activities use the same set of cards (pp.15g-i). Because of the close connection between the traditions of the Hispanic vaquero and the North American cowboy, the labels for these games are given both in Spanish and in English, and the "caller" might call the game in either language.

Cowboy Bingo is played in the same manner as a traditional Bingo game. There are 5 players' cards (pp.15e-i), and players have chips or other markers with which to cover the items on their cards as they are called by the "caller." The caller's cards (pp.15g-i) are labelled, and he/she holds up each picture and calls its name in English or in Spanish. The players who have that particular item pictured on their cards mark the illustration with a chip. In this game, some items (such as the boots and the spurs) are pictured in both a plain and a fancy version. **Players must have an exact match to mark their cards.** The winner is the person who first marks all the items on his/her card.

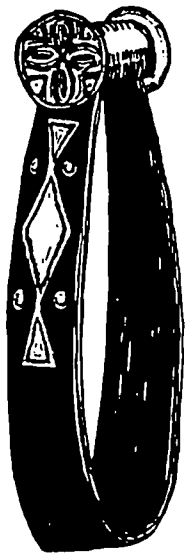
A variation for students learning Spanish would be for the caller to call the Spanish name without showing players the picture.

Auction is played using the caller's cards only. Prices listed on the backs of the cards indicate the cost of the items in the mid- to late 1890s. In this game, the caller holds up the picture and players try to guess its cost. The player who comes closest without going over the cost wins the card. If everyone goes over the price, the card goes to the caller. After all the cards have been "auctioned", the winner is the player with the most cards.

A variation of *Auction* can be played after students have completed the *Trail Drive Simulation.* Once they have received their "wages" at the end of the trail, they can "shop" among the items pictured on the cards and make a list of what they would purchase with their earnings.

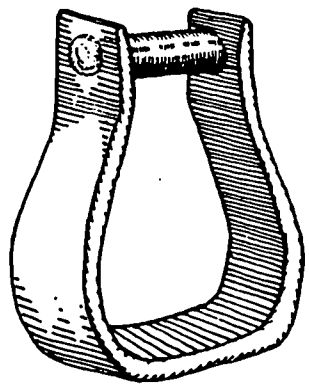
Caller Cards 9.

up



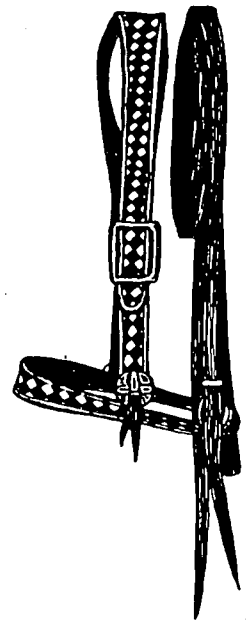
El estribo

Stirrup



El estribo

Bridle



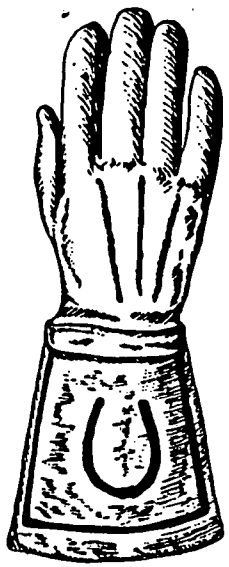
La brida
El freno

Bit



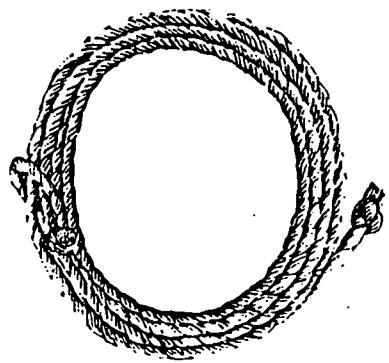
El brocado del freno

Glove



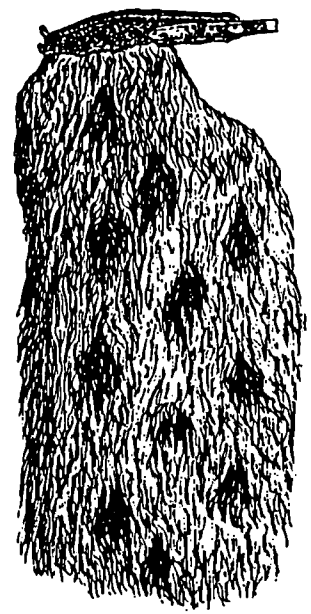
La guante

Lariat



La reata
El lazo

Chaps "Woolies"



Las chaparreras

Chaps



Las chaparreras

$8.00

$2.50

$12.00

$2.25

$2.00

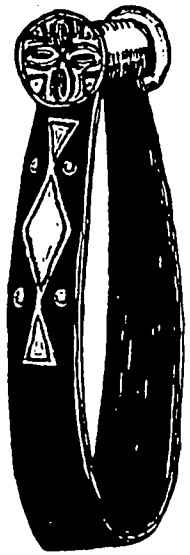
$.20 per pair

$1.15 per pair

$2.50 per pair

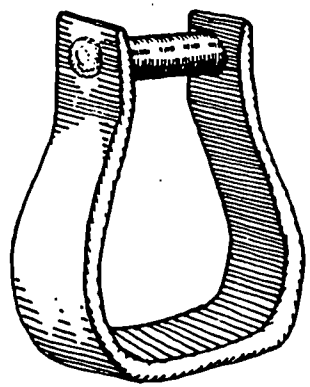
Caller Cards 9.

up



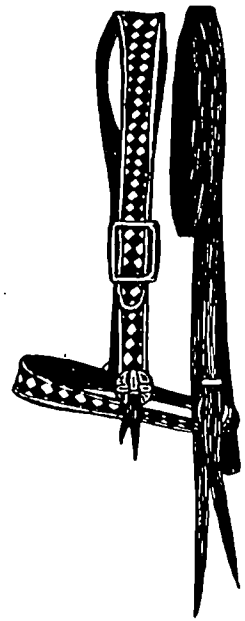
El estribo

Stirrup



El estribo

Bridle



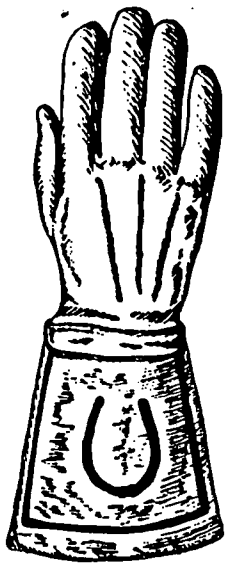
La brida
El freno

Bit



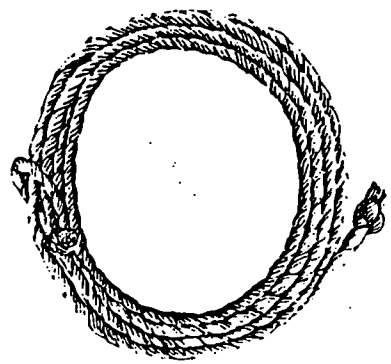
El brocado del freno

Glove



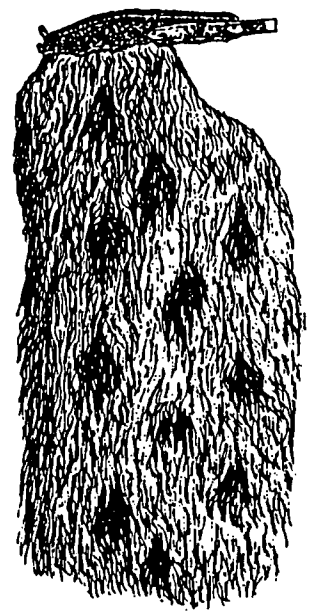
La guante

Lariat



La reata
El lazo

Chaps "Woolies"



Las chaparreras

Chaps



Las chaparreras

$8.00

$2.50

$12.00

$2.25

$2.00

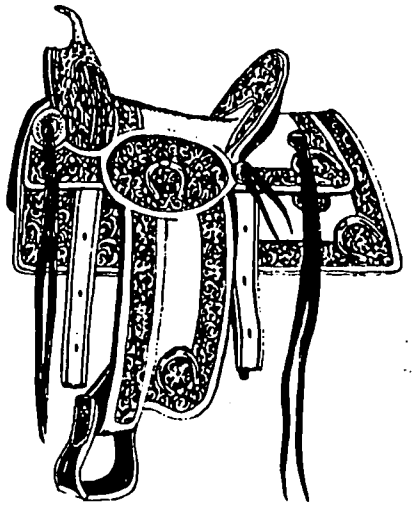
$.20 per pair

$1.15 per pair

$2.50 per pair

ERIC

...le



La silla de campo

Saddle



La silla de campo

Boot



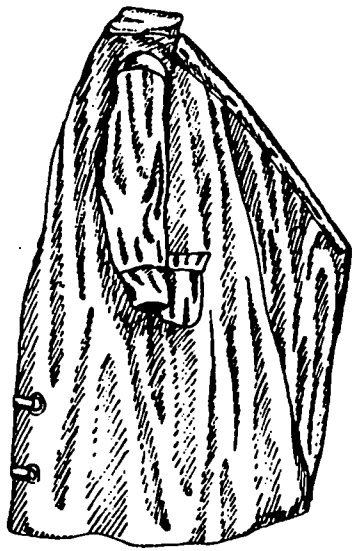
La bota

Boot



La bota

Slicker (raincoat)



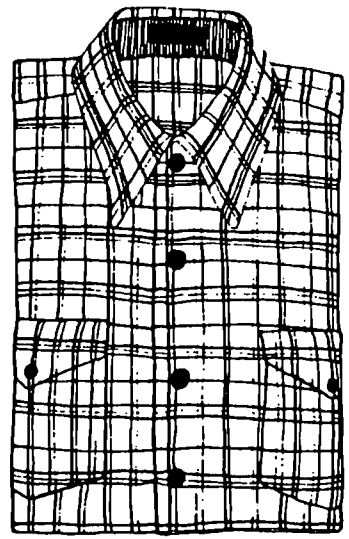
El impermeable

Pants



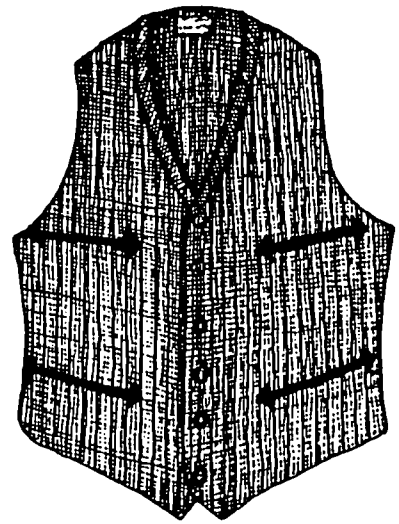
Los pantalones

Shirt



La camisa

Vest



La camiseta

$1.50

$4.00 per pair

$.90

$8.50 per pair

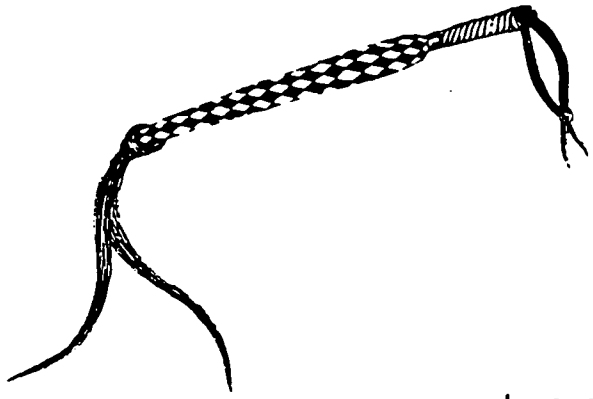
$1.15

$37.25

$2.85

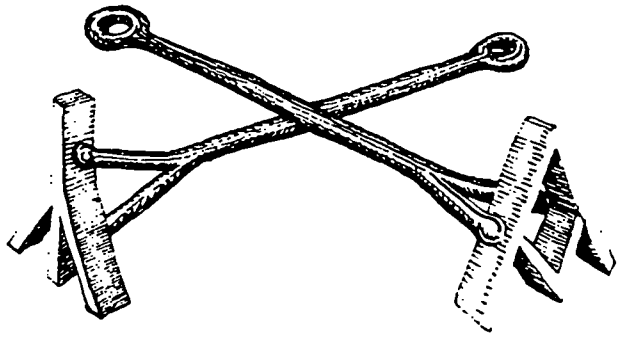
$95.00

Quirt



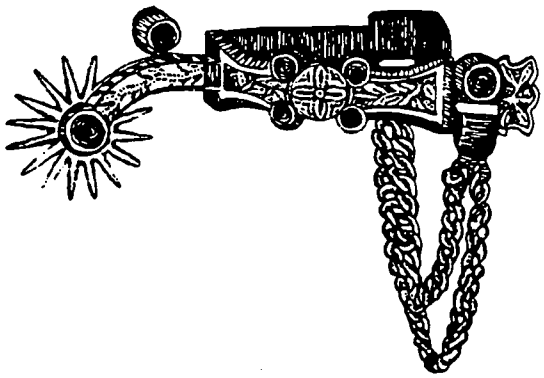
La cuarta

Branding irons



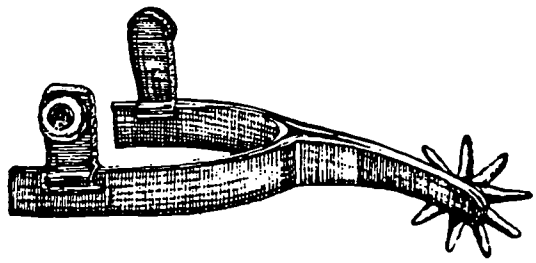
Los fierros

Spur



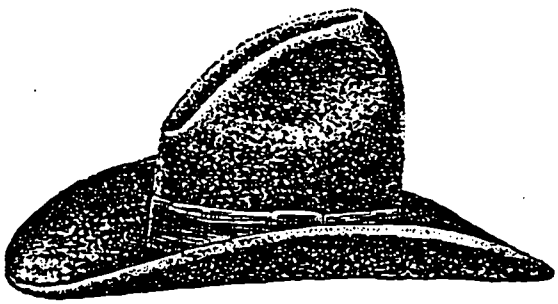
La espuela

Spur



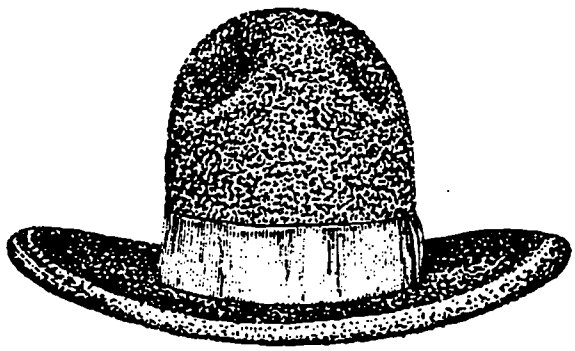
La espuela

Hat



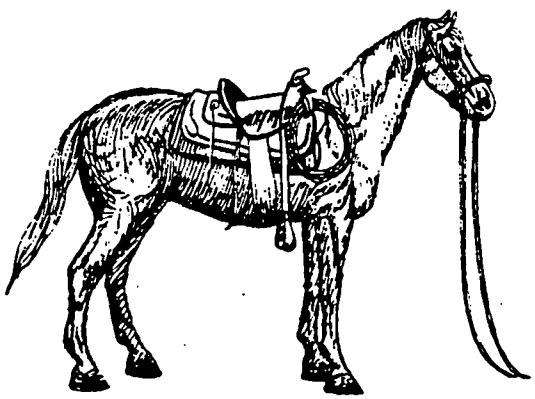
El sombrero

Hat



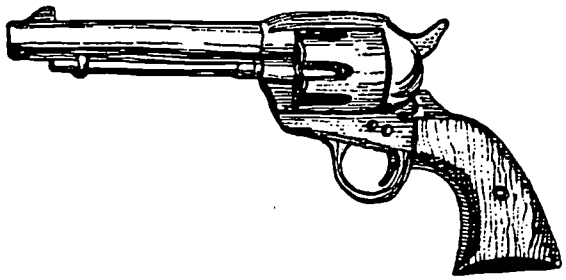
El sombrero

Horse



El caballo

Pistol



La pistola

$.50 each

$2.00

$1.00 per pair

$10.50 per pair

$3.00

$5.95

$12.95

$100.00

Saddle blanket

El cojin
El baste

Holster

La funda

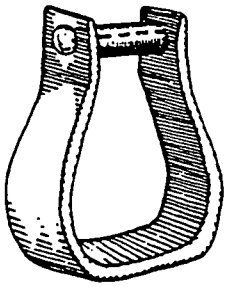
Bedroll (bedding)

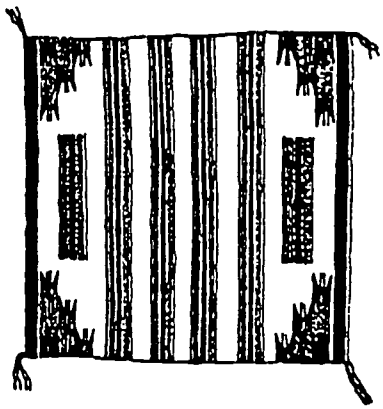
Ropa de cama

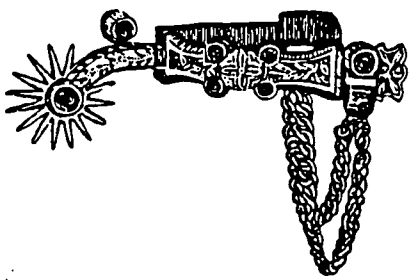
Bandanna

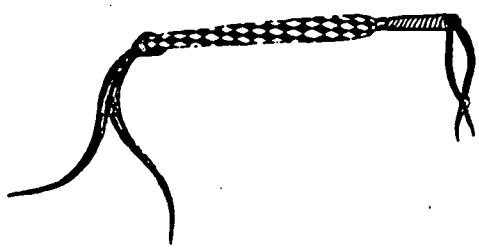
El pañuelo de cuello

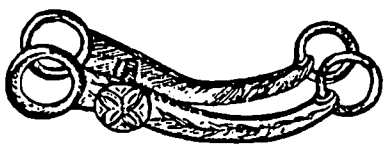
Player Cards e.

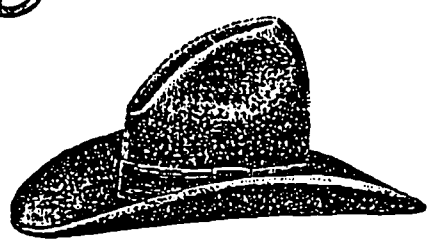


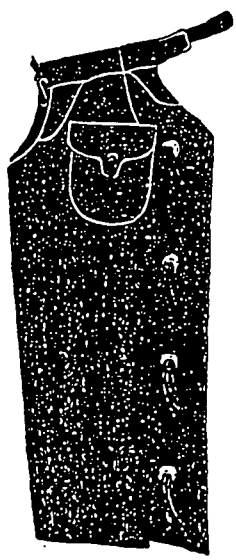




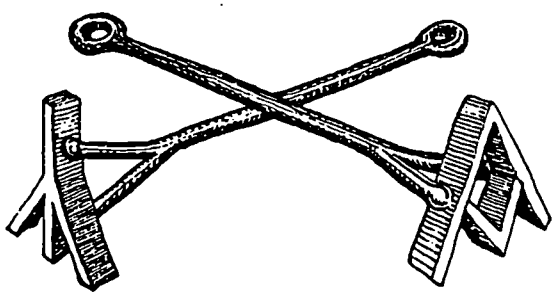




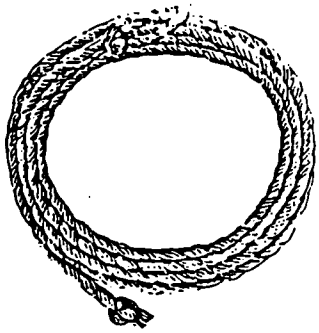


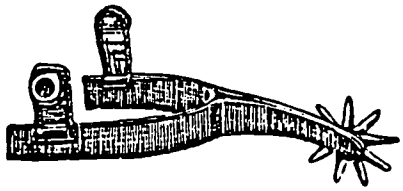




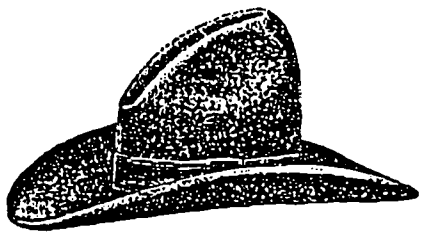


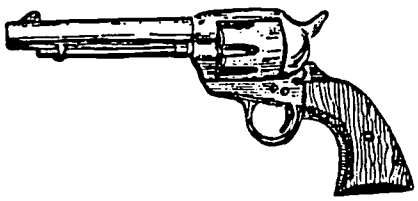
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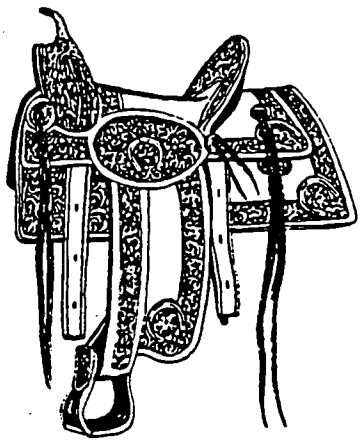


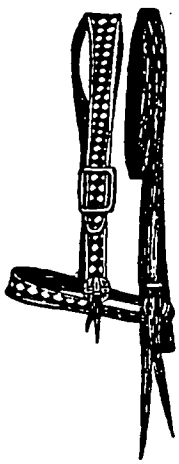


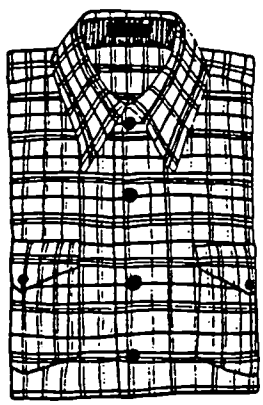


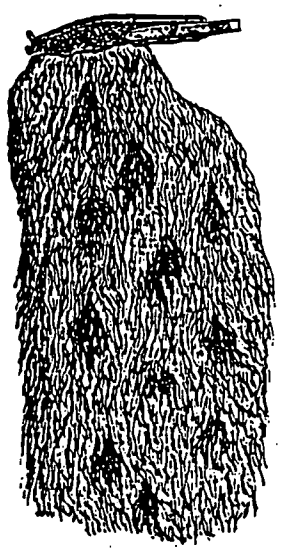




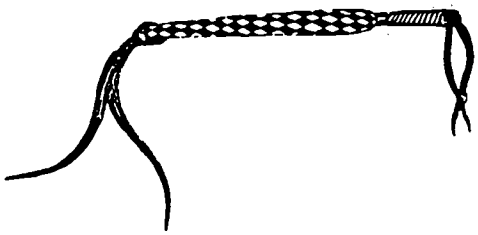




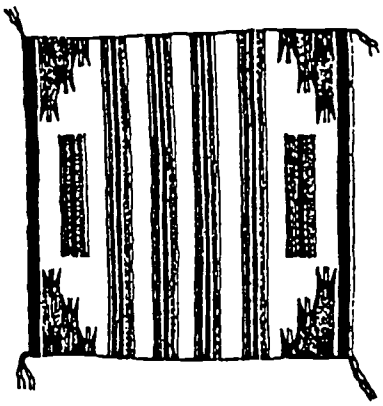




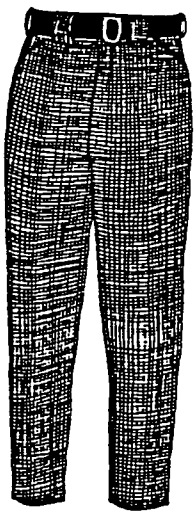


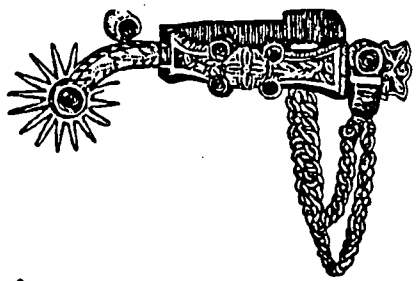


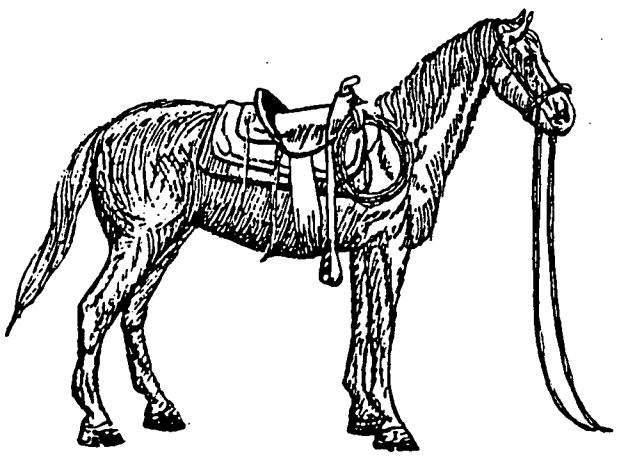


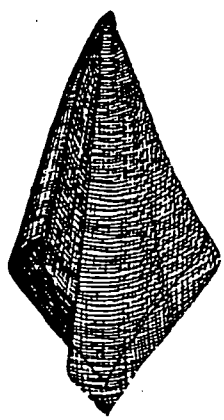


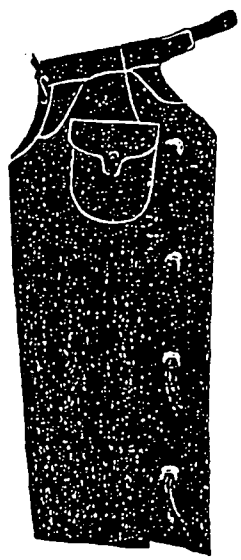






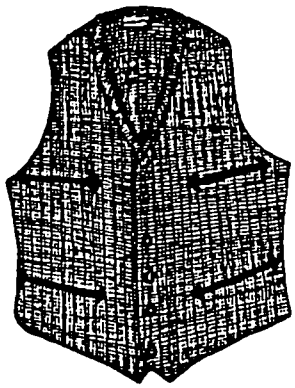


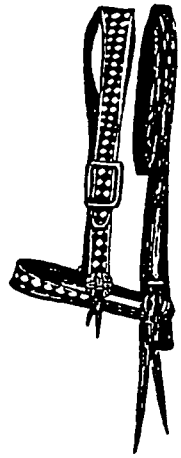




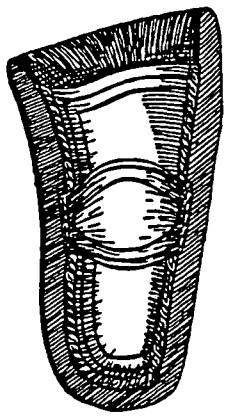
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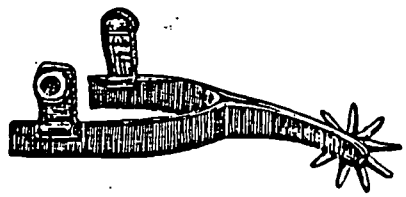




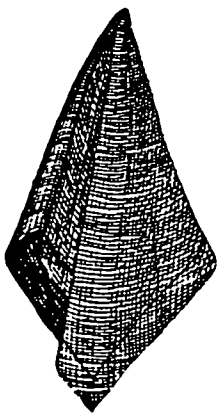


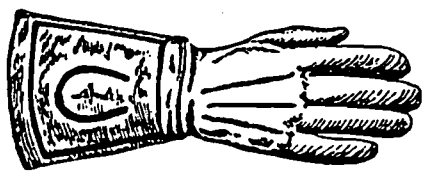


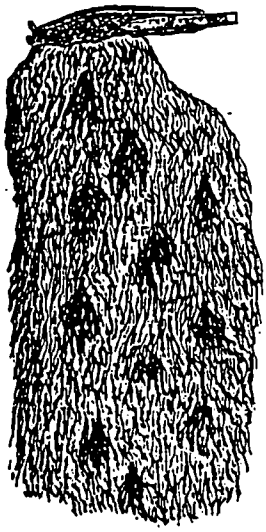


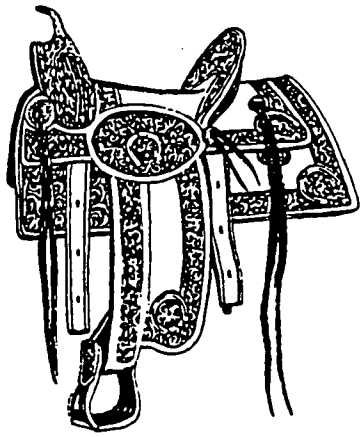


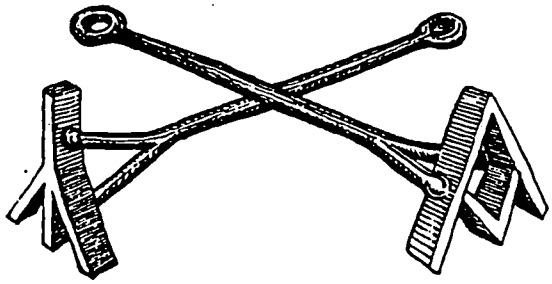






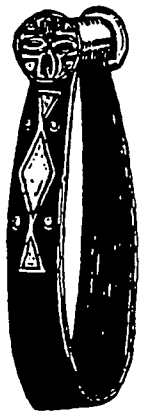


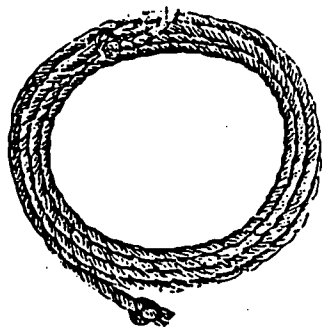


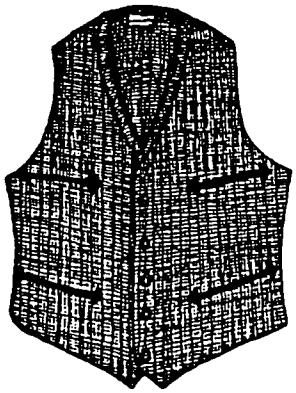


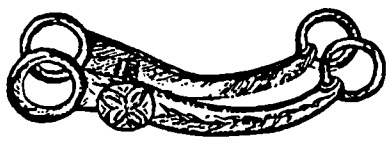












Ranch Life

In the days of the open range, most cowboys were itinerant workers. They might be "hired on" to work a round-up or a trail drive in the spring or summer months, but only a few would be kept on through the winter when there was less work to be done on the ranch. Those who did keep their jobs through the cold months often spent weeks in isolated and primitive "line camps" where they could keep an eye on the rancher's far-ranging herd.

Sometimes cowboys without work would keep themselves fed by moving from camp to camp or bunkhouse to bunkhouse. Because of the traditions of hospitality on the range, they nearly always were fed and given shelter, and because of the loneliness of the isolated camps they usually were welcomed. The men who survived the winter this way were called "grub line riders", and according to cowboy Teddy "Blue" Abbott, they "were very welcome wherever they stopped, because people who had been shut up all winter were glad to see new faces. They brought news of the range."

The return of warm weather stimulated activity as preparations began for the spring round-up. Since the cattle roamed freely on the open range without fences to confine them, the herds of several owners in an area were mixed together. Spring was the time to separate and count the cattle, brand new calves and doctor any ailing animals. Extra cowboys were hired to accomplish the work. In some areas scores of cowboys from a dozen ranches might be required to cover several hundred square miles of range.

Essentially, a group of cowboys would be dispatched to different parts of the range and would work back toward a designated rendezvous point, driving all the cattle they found before them. When they reached their destination, calves were separated and branded with the brands of their mothers. For the cowboys, it was hard, dirty work, but it was also an opportunity to socialize with the other hands and to show off roping and riding skills before an appreciative (and critical) audience. Besides working the round-up in their own areas, ranches sent representatives to round-ups in neighboring areas to pick up strays with their brands. To quote Teddy Abbott again, "...the round up was something everybody looked forward to, on the range. You got to see a lot of people that way and hear the news. Cowpunchers was alone so much, that was why they appreciated company."



"*A Bucking Bronco*" by Frederic Remington, 1888

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In the post-Civil War era of the range cattle industry, both Mexican and black cowboys were numerous. Mexicans, of course, were part of a long tradition of working cattle going back to the Spainards who first developed ranching in this hemisphere. Prior to the Civil War, black slaves in Texas and elsewhere had labored on cattle ranches, and had learned well the craft of cowboying. Following emancipation and the post-war boom in the cattle industry, other blacks were attracted to an occupation where they received the same wages as their white counterparts and where their skills could earn a measure of acceptance or even approval. No one knows for certain the number of either Mexican or Afro-American cowboys of this era, although their presence seems to have been substantial. Records were kept on cattle, but not on cowboys!

In addition, many Indians worked as cowboys, particularly in Indian Territory, where a number of Native Americans operated large ranches, and where grazing land was leased by many non-Indian cattlemen.

Women were, of course, an important part of ranching families. As in other pioneering groups, they often were needed to pitch in and help with the hard, dirty work of the family livelihood in addition to the chores of running a household and raising children. As one female resident of Texas wrote in 1836, "It's not uncommon for ladies to mount their mustangs and hunt with their husbands, and with them to camp out for days....All visiting is done on horseback, and they will go 50 miles to a ball with their silk dresses...in their saddlebags." (Mary Austin Holley, *Texas*, The Steck Co., 1935—a reprint of the original 1836 edition.) Many women, however, were ranchers in their own right with all the attendant risks and responsibilities.

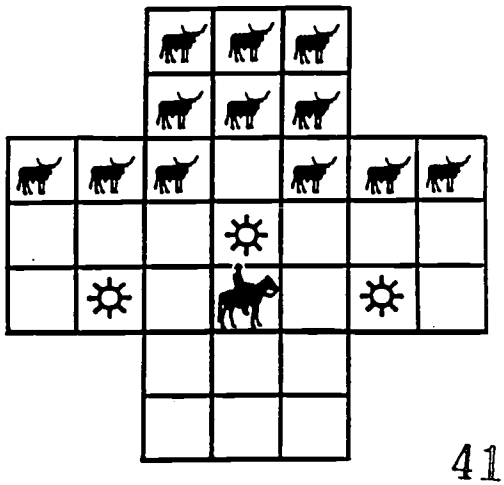
There is at least one recorded instance of a young woman disguising herself as a boy and working as a trail drive hand for several months (The Trail Drivers of Texas, edited by J. Marvin Hunter). The life of the roving cowboy, however, was a male occupation.

Activity

Round-up Game

This is a game for two players. One player is the "Cowboy" and moves the game piece, trying to capture cows. The other player is the "Cattle" and moves the "cows" (chips) who try to escape off the board. The game is played twice to determine who is the better cowboy.

1. Set up 12 chips (the cows) and 1 game piece (the cowboy) on the board as shown in the diagram.



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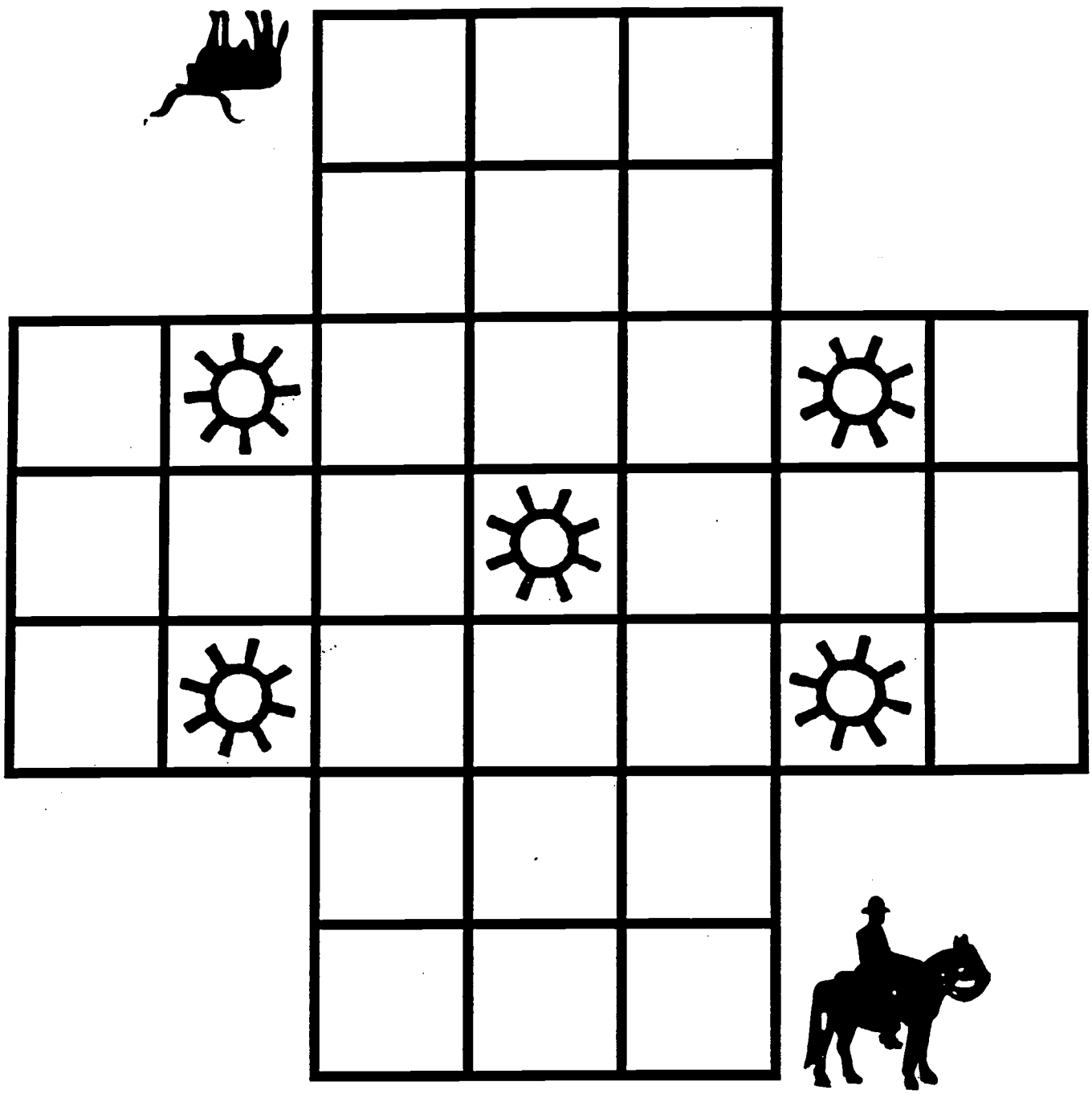
2. The Cowboy moves first. He/she may move one space at a time in any direction. The cowboy captures a cow by jumping over it into an open space. The cowboy can make double or triple jumps (as in Checkers) if there are open spaces between the cows.

3. One cow at a time may move one space forward, sideways or diagonally, but it cannot move backward toward the starting position. Cows cannot jump over the cowboy. If a cow makes it all the way to the opposite end of the board and off without being captured, it has escaped.

4. When either a cow or the cowboy moves onto a marked space (see the game board, next page), the player takes the top card from the Fate Deck, reads it aloud and follows its instructions. (Some of the cows start from a marked space; they do not take Fate Cards unless they move onto such a space later in the game.)

5. If the Fate Card allows either "cowboy" or "cattle" to replace a cow on the board, the player may replace it on any space.

6. When all the cattle are off the board, "cowboy" should count to see how many cattle he/she has captured. Then players switch roles (i.e. the player who was "cowboy" becomes "cattle"). The game is played again. The cowboy with the highest score after both games is the winner.



Years of experience help the cowboy work the cattle without causing problems. "Cowboy" may capture any cow on the board.	The cowboy has trained a dog to help with the herd. If any cows have "escaped", the cowboy may replace one on the board.	The cowboy brings in a bunch of cattle, but one balks and refuses to move into the corral. The cow runs off to one side, gets turned back and runs through the whole herd. She escapes, and several other cows try the same thing. "Cattle" gets an extra turn.	You're in hilly country. Horses have to move more carefully while going downhill than cattle. A steer gets away while the horse is moving down a steep slope. One cow may escape off the board.
Fog makes it impossible for the cowboy to find any landmarks. "Cattle" may have an extra turn.	It's a hot, sunny day and cattle are grazing around a water hole, where they're easier to find and gather. "Cowboy" gets an extra turn.	While roping calves, "Cowboy" gets the rope crossed with someone else's. The calf gets away and the cowboy gets teased for the rest of the round-up. "Cattle" gets an extra turn.	It's early in the day when rattlesnakes are more active. The cowboy is chasing a steer, which gets by the snake, but his horse is bitten. "Cattle" may take an extra turn.
Cowboy and horse are running full tilt after a steer when the horse steps in a gopher hole and the cowboy is thrown. "Cattle" may return one cow to the board if any have been captured.	It's a drizzly day and the cattle are lying down in low places. They are hard to spot. "Cattle" may take an extra turn.	A group of cattle have bunched up along a drift fence, making them easier to gather. "Cowboy" may have an extra turn.	The cowboy's horse is young and not yet well-trained. If he/she has captured any cows, "Cattle" may return one of them to the board.
A storm is moving into the area. The cattle are "antsy" and hard to drive. "Cattle" takes an extra turn.	It's a crisp, clear morning and an easy drive back to the corral. "Cowboy" gets an extra turn.	A big calf kicks his way out of the cowboy's hold. "Cattle" takes an extra turn.	A well-trained horse gives the cowboy an advantage. "Cowboy" may capture any cow on the board.

What's A Kid to Do?

Children born in a ranching family were often expected to begin working around the homestead very early in life. However, kids were allowed to let off steam after the chores had been done. Spring roundup and fall gathering of the cattle brought family and friends from neighboring ranches out for the festivities. Most popular were the games the children, and sometimes the adults, played for prizes of ribbons and candy. Other events such as town fairs, church socials, barnraisings and 4th of July were also times to compete in individual and team games.

The following activities are simple, and require very little instruction and equipment; weather is a factor since most games were held outdoors. The very young to teenage children will have fun learning and playing these games. They can be conducted on the ranch grounds in the lower yard, or in the school yard prior or post field trip.

Three-Legged Race: Teams of 2 students tie a ribbon, string, twine or handkerchief around their legs that touch while standing side by side. They will want to balance themselves by placing their arms around the shoulders of their partner. The object is to move the tied legs in synch, down a lane as fast as possible. This game requires team-work and cooperation, and a little coordination wouldn't hurt! The length of the course can vary depending on the age of the children; longer for older kids, shorter for small children.
Boys and girls can compete together or separately, with several heats and a final race. Handmade prizes could be given out to the winners, or to all participants.

Sack Race: Burlap bags are used for this race. The children step into the bags and roll them up around their waist, holding the excess in front of them in one hand. They will use their other hand for balance. Line them up on the starting line, and at the signal, they jump with the sack, hopping their way to the finish line. This may take some practice but is a lot of fun.

Egg and Spoon Relay Race: Divide the class in half, making two teams, or divide further for more teams. There should be an equal number in each team. Each team member receives one metal spoon, regular teaspoon size, and a fresh egg (one per team). With the egg resting in the spoon, the first student moves as quick as possible to a turn around point (cones, blocks or some other marker could be used) some distance from the start. He rounds the point and returns to his team, passing the egg into the spoon of the next team member. The object is for the first team to finish the relay without breaking its egg.

Water and Spoon Race: The object here is to carry a spoonful of water at a time and place it in a container that has a small, lightweight object in it, which will float when enough water is place in the container. Baby food or jelly jars work well with a small wood chip, ball, etc. inside. Students have a larger container of water at the start line that they dip their spoons into before running to the opposite end of the relay. You may use a larger metal, wooden or plastic spoon for this race. Only one spoon per team, so they hand off to their teammates each pass. The winner is determined when the object in the teams' small jar floats out the top.

Clothespin Drop: Using the old fashioned wooden clothespins, and a narrow-necked milk bottle, students attempt to drop them one at a time into the bottle while standing over it. The first team to get all their pins in the bottle wins.

Bean Bag or Egg Toss: Divide the class into pairs; give each one either a bag or egg, and have them stand opposite each other, facing. There should be about a foot apart to begin with. Have the person holding the object toss it to his partner, and if he catches it, move back one step. Then the partner throws the object back, and if the first person catches it, he moves back one step. If the person misses, they are out of the game. The winner is the last pair tossing the object with the partner catching it. Be prepared for cleanup if using fresh eggs! An extension would be for the class to make their own bean bags for this game. Most children in the 1880's knew how to whittle wood and sew, as a matter

of relieving boredom, and as preparation for adult life.

Cup and Ball, Blacksmith Puzzles: These are items that were made by or for children in the 1880's for entertainment. They were designed as toys for individuals to play with by themselves. Use the ones in the Cowboy Trunk to talk about activities that pioneer children did compared with todays kids. Would the class enjoy making and playing with their own toys, using materials found around the house? How long do they think they could play with something like these before getting tired of it? What else could children do in their spare time to occupy themselves? in the 1880's? 1940's? Now? This would be a good topic for further study and research by the class or individuals.

The Trail Drives

Texas Civil War veterans returned home after the war to find that the longhorn cattle had multiplied on the open range. Beef was scarce in the Eastern cities, and the price was high. If the ranchers could get their cattle to the railroads, where they could be shipped to eastern markets, there was money to be made. And the longhorn was a product that actually could walk itself to market! Herds had been driven over long distances before the war, but suddenly the incentive was there for many ranchers to move large numbers of cattle to the railheads. Besides the dangers and difficulties of such a journey, cattlemen also faced the hostility of homesteaders along the route. Not only was there a possiblity of considerable damage to a farmers' crops when a herd of 2,000 or so longhorns wandered through the area, but settlers were also troubled by the so-called "Texas fever" that seemed to follow the herds. (This disease was later found to be caused by ticks. The longhorns were immune, but other breeds of cattle died from the fever passed on by the ticks the travelling herds left behind.)

Most of the ranchers tried to follow trails that would avoid the more settled areas, but as the railroads built further west across Kansas and Nebraska, the homesteaders tended to follow. Partly as a consequence of these factors, and because markets began to open up in Montana and other northwestern areas, the westernmost trails (of those open) tended to get the most use.

Thus, of the trails that crossed Indian Territory (now Oklahoma), the Shawnee Trail was used more before the Civil War, the Chisholm Trail during the late 1860's and early 1870's, and the Western Trail from the mid-70's into the '90's. (See map on p. 40)

Generally, a drive was made with 2000 to 2500 head of cattle. This required about 12 cowboys, a cook with chuck wagon and team, a wrangler with a herd of about 40 horses and a trail boss to oversee the entire operation. The trip could take from 3 to 5 months, depending on distance and circumstances. The herd might move from 8 to 15 miles per day, and they were rounded up into a compact bunch for the night. They were watched through the night by two cowboys riding in opposite directions around the sleeping cattle. Singing seemed to help keep the herd calm, so the men usually crooned to the cattle, and often created their own songs or added new verses to popular



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A Post Office In The "Cow Country (Latest news) by Frederic Remington, 1901

tunes. This two-hour stint of night guard added to the crew's already long day, which started around 4 A.M. Some of the old-time cowhands talked about the lack of sleep as one of the greatest hardships of the trail.

Other hardships there were in plenty, however. Crossing rivers could be particularly hazardous, due to floods or quicksand. Many of the cowboys didn't know how to swim, and had to rely on their horses while they entered the river again and again, urging the herd across. A horse that could swim well was prized, and saying of a cowboy, "he'll do to cross the river with" was a high compliment.

Everyone also dreaded "a dry crossing," a period of one or more days without water. In these circumstances both men and animals could suffer enormously, and the cattle actually could go blind from thirst. (They recovered once they were well-watered.)

Stampedes, too, were greatly feared. They generally happened at night, and the cattle could be set off by almost anything: thunder or lightning, a coyote's howl or even a match striking. Stampeding also appeared to be habit-forming, so that an outbreak early in the drive was not a good omen. Besides the obvious dangers for both men and animals in racing full tilt across the prairie in the dark, the run caused the cattle to lose weight. A steer running four hours can lose up to 50 pounds. This affected the price the animal would bring. A major part of the job description for the trail boss was to deliver the animals in good condition. One owner was known to offer every man in the outfit a new suit of clothes if they got the herd to the railhead without a single stampede.

At the end of the trail the cattle were loaded onto railway cars and the cowboys received their pay: $30-$40 per month. (The cook received about $60 per month and the trail boss, $90.) The hazardous, demanding work paid about "a dollar a day and found," meaning wages and meals. Nonetheless, most cowboys took enormous pride in their work and hated to hear that they'd been bested by another outfit.

Here is a description from *The Chickasaw Rancher* of cowboys trailing a herd up the famous Chisholm Trail:

> The cowboys rode, hunched over in the saddle, faces
> half covered with bandannas to keep out the
> stifling dust. Their eyes were red and bloodshot
> from the dust and ...the blazing sun. Their clothes
> were oftentimes torn and travel worn, almost
> in shreds.... Many of them were racked with
> typhoid and malaria germs. Reckless from thirst,
> they oftentimes drank from the first water they
> found, whether it be muddy, brackish, hot or cold.
> ...To help them endure the thirst, some placed small,
> hard sandstones in their mouths and sucked on them.

And this was at Silver City, in Indian Territory, less than 2/3 of the distance they had to travel!

Once the goal was reached, and payday was at hand, the cowboys were ready to celebrate. The famous cowtowns of Kansas—Abilene, Newton, Wichita, Caldwell, Dodge City—were well

time. First order of business was often a bath and a shave (about 25 cents at the local barber shop), and then perhaps some new clothes. Then the saloons with their gamblers and dance hall girls beckoned. And while not all cowboys succumbed, many did. Their celebrations could get drunken and out of hand, so several of the famous lawmen of the west (such as Wild Bill Hickock and Wyatt Earp) earned their reputations trying to keep the peace. Most towns, in aid of that goal, eventually passed a law that guns had to be left with the sheriff during the cowboys' stay in town.

Celebration over, the cowhand (often broke by this time) had to make his own way home to Texas, or look for another outfit to hire him on as a hand. Cowboying was not a way to financial security, nor even a good way to support a family. Partly for this reason, most of those who went "up the trail" were young men, barely out of their teens. The viciously hard work wore the body down too, so many of these men moved on to other occupations after some years. Often in later life, however, they still thought of themselves and preferred others to think of them, as cowboys. It was, and is, a proud tradition.

Activity

The following classroom activity offers students an opportunity to imagine themselves as members of a trail drive crew of the 1870's. Each team will be responsible for driving a herd of 2000 cattle from San Antonio to either Abilene or Dodge City. Although the simulation takes at least 6 sessions of 45 minutes each, it incorporates activities in several curriculum areas: social studies, language arts and math. A day-by-day schedule, with lists of worksheets necessary for each day appears on page 29.

Students, working in teams, will drive a herd up the trail by moving a game piece on a map. Fate Cards will describe incidents and circumstances during the drive, and at 3 places along the trail, each team will have to stop and make a group decision regarding a situation they are facing. At the end of the drive, each team or "outfit" will calculate the total price for cattle delivered, determine wages and expenses, and find out how much profit they were able to make for the cattle owner. (They themselves receive only 3 months' wages—usually about one dollar per day!)

Trail Drive Simulation

Divide class into 4 teams or "outfits."

Pre-game Activities

1. Map worksheet and cattle trail map. (pp. 35-36)

2. Worksheet describing duties of each member of the trail driving crew: Each outfit is to elect a trail boss and "ramrod" (second in command). The trail boss will keep trail records. He/she should be good at math. The ramrod will keep track of whose turn is next, and will assist trail boss. Remaining members of the outfit are to draw to determine their trail positions: point, swing, flank, drag, wrangler, cook. These will indicate the order of play. Ramrod will make a list and keep track. (pp. 37-38)

3. Supplies worksheet: Outfit will discuss list of needed supplies and will vote on which "bonus" supplies to take along. Each outfit may choose any two from the following list: Extra wagon wheel; extra rope; 4 extra cowboys; 20 extra horses; canned tomatoes, peaches, and milk; $500 in extra expense money. (p. 39)

4. Trail Record: Not counting bonus choices, each outfit will start with 14 cowboys, 80 horses, 2000 head of cattle, $1000 expense money. (Penalties occur when the number of cowboys falls below 11 or the number of horses below 75.) (p. 40)

5. Brands handout: Each outfit will choose (or design) a brand. (P. 41)

6. Journals handout: Each student will become familiar with 2 historical journals in preparation for keeping his/her own trail drive diary. (pp. 31 -34)

How To Play "Trail Drive"

Object of the game: to reach the railhead with the healthiest, largest herd and to get the best price for one's cattle.

Materials: One game board (trail map following p. 41); 4 game pieces and 4 dice (1 game piece and 1 die per team or "outfit"); Fate Cards and River Crossing Cards (pp. 39-42); Decision sheets and Consequence pages (pp. 42-53). Additional worksheets (pp. 37-38) are needed for the pre-game preparatory activities.

Before play begins: Divid The class into 4 teams or trail drive outfits. Outfits draw to see which two will go up the Chisholm Trail in 1871, and which two will go up the Western Trail in 1877. (They will actually move simultaneously. We're dealing with a time warp here, because historically the two trails were not in use at the same time.)

Course of play: Unlike other games, the die is <u>not</u> used in Trail Drive to determine how many spaces to move. Instead, each player moves the outfit's marker forward **one space** (a hoofprint) on the trail when it is his/her turn. If the space indicates (by a patterned hoofprint or colored dot), the player takes the top FATE CARD from the pile, reads it aloud to the outfit, and follows its instructions. There are 2 kinds of FATE CARDS: general cards and river crossing cards. When a player reaches a Decision space, he/she must get the appropriate Decision sheets from the teacher for his/her outfit.

1. Speckled hoofprints (or green dots) indicate that the player should take a Fate Card.
2. Spotted hoofprints (or blue dots) indicate River Crossing cards.
3. A plain white hoofprint indicates a period of several days during which all goes well on the trail.
4. Solid black hoofprints (red dots) indicate a Decision.

Sessions of play: Play will take 4 sessions (each represents 3-3 1/2 weeks on the trail) and each session ends with three activities:

1. The trail boss will check the Trail Record for that day's play to see if the loss of cowboys or horses results in any penalties. (If the number of cowboys falls below 11, 100 head of cattle are lost each time a cowboy is lost. For each horse below the number of 75, 50 head of cattle are lost.)
2. Decision making: each outfit will have to discuss and vote on a decision regarding some circumstance facing them on the trail. The consequence of their choice is revealed at the beginning of the next session's play.
3. Diary entry: each student ends each session with a fictionalized journal entry detailing the happenings of that day's session.

Rules of play:

1. Both trail markers (herds) may occupy the same space at the same time. (Although real herds would be kept some distance apart to avoid mixing them, players need to be able to occupy the same space for the sake of the game.)
2. Outfits are penalized if their number of cowboys falls below 11 or their number of horses falls below 75. **(100 head are lost for every cowboy below 11; 50 head for each horse below 75).** These penalties are reflected in the Trail Record kept by the trail boss.

Movement on the trail: For the first round of play, decide the order in which the four outfits will take turns. Have students from each outfit move the trail markers forward and take FATE CARDS or RIVER CROSSING CARDS if indicated. The player should read the card aloud to the whole class, and his/her outfit (team) should follow the directions on the card. Once the process seems clear to the class as a whole, **outfits may operate independently and need not wait for the other teams before moving ahead.** (In this case, a player reads the card only to his/her own outfit, not to the whole class. Emphasize the importance of reading the cards aloud so everyone on the team knows what is happening.)

NOTE: Suggest to players that they place their game pieces next to the hoofprints instead of on them, so that the other outfit on their trail can see the markings clearly.

A player's turn: If a player draws a card which indicates the die should be rolled, that player rolls the die. If the card says to stay in place until a certain number is rolled, again it is the responsibility of the person taking the turn to roll that number. If two numbers are required, they must be rolled in the order they appear on the card. However, they need NOT be rolled consecutively.

End of session: The day's session ends when a Decision space is reached. Then students get the appropriate worksheets from their teacher to begin decision-making process. (See pp. 42-47) Decision sheets are to be filled out individually **by each student** before the group discusses the possibilities. (This will enable each student to think through the possible actions instead of quickly following the lead of the strongest group member.) After they are finished, **then** the entire outfit should decide what the group will do. They register their final decision with the teacher and then begin work on that day's diary entry. The trail boss must check the trail record at the end of each session to see if the team has received any penalties due to lost men or horses. The record should be adjusted accordingly.

Beginning of next session: If the previous session ended with a decision, the teacher begins by reading the consequences of each outfit's final choice. The outfits follow the instructions given before beginning to move again up the trail. (see pp. 48-53.)

End of play: When an outfit reaches its destination (Abilene, Ellsworth or Dodge City), they receive an **Account Sheet** (p. 55) from the teacher. Working from their Trail Record, they will calculate final expenses (salaries), and the number of head delivered. A final roll of the die and a Cattle Price Table (p.54) will tell them how much they receive per head. A final accounting will determine which outfit had the most successful drive. (Teachers may wish to "walk through" this activity with the whole class, depending on the level of the group.)

Further play: After students have been "up the trail" once with the whole class, they may wish to play individually. By eliminating the diary entries and the written part of the decision making process, Trail Drive can be used as a board game for 1-4 players.

Teacher's Notes: "Trail Drive"

1. On the first round of play, have groups wait until each team completely finishes a turn before the next begins. This will give each team an opportunity to hear the kinds of fates that befall other groups, and it will also be easier for the teacher to model the record keep ing process. On successive rounds, teams may be able to operate more independently of one another.

2. For younger or less adept groups, copy 4 trail record forms onto the board (one for each team) and have the class work through the math together.

3. When a team or "outfit" reads their Fate Cards, they should keep the cards until the end of that day's session. In this way, the cards will be available for review before the members of the team write their diary entries. (Collect the cards before actual writing begins, however, to encourage students to recount events in their own words.) Place the cards at the bottoms of the appropriate piles before the next day's play begins.

4. The consequences of the decisions to be made at the end of each day's playing session should be kept secret from the students until after they have considered and agreed upon their choice of action. If they decide upon an option they have created themselves, the teacher will determine the appropriate consequences. (Or class discussion might be held to consider what the consequences could be.)

5. Account Sheets (tabulated at the end of the game) are set up as word problems. Some groups may benefit by having the class as a whole discuss the problem and agree upon which arithmetic function to use to find the correct solution.

Daily classroom schedule for Trail Drive Game

Day 1: Presentation on historical background about cowboys and cattle trails; discussion of diary samples (see pp. 3-36) and of the student's own journal assignments, which will begin on Day 3. Introduce the Trail Map and the basic rules for playing Trail Drive. (45 min. - 1 hour)

Day 2: Pre-game activities and work sheets (45 min.)

Teacher preparation: Divide the class into 4 teams; copy the handouts (map and map activities, job descriptions and trail positions, supply list, brands description—one per student; Trail Record—one per team.)

a. Discuss the map and do map activity sheets, either as a group or individually.
b. Divide class into teams or outfits
c. Discuss the job description handout. Have teams elect trail boss and ramrod. (Trail boss should have good math skills; ramrod will take over if trail boss is absent during play.)
d. Discuss the supplies handout. Outfits should choose 2 items from the bonus list, and the trail boss should write their choices on the trail record sheet.
e. Discuss the trail positions handouts. The ramrod for each team will f fill in the trail positions to determine the order of play.
f. Discuss the brands handout. The teacher should assign brands or have each group choose one.

Day 3 Outfits review Trail Record Sheet and begin moving up the trail.

Teacher preparation: Copy Decision Sheet 1: Chisholm Trail (enough for each member of the two outfits moving up the Chisholm) and Decision 1: Western Trail (enough for each member of the two outfits moving up the Western).

a. Explain how each team will move "up the trail" until they reach a Decision Space. Tell players about penalties for falling below 11 cowboys or 75 horses. Point out to students the two kinds of cards (Fate Cards and River Crossing Cards). When a player lands on a River Crossing space, a card is taken from that pile; when a player lands on a Fate space, a card is taken from that pile.
b. Begin the game. For the first round, have teams move one at a time and read their Fate Cards aloud to the entire class. After they see how the game works, teams may move independently with players taking turns according to their trail positions. **Each team should stop when they reach the first Decision Space**, and get the Deci sion 1 worksheets for the trail they are traveling.
c. Individuals fill in their Decision worksheets.

d. Teams discuss the possible actions and vote on their final decision. They mark this on their sheets and turn them in to the teacher.
e. Each student reviews his/her team's Fate Cards and writes a journal entry.

Fate Cards and River Crossing Cards are replaced at the bottoms of the appropriate piles.

Day 4 Outfits continue up the trail

Teacher Preparation: Be ready to read the consequences of each team's choice of action for Decision 1 (see pp. 48-49). If any team has chosen to come up with their own solution, prepare a logical consequence. Have copies of Decision 2 worksheets.

a. Consequences of Decision 1 are read and the instructions are fol lowed.
b. Each outfit continues "up the trail" to the second Decision space (at the Red River).
c. Individuals fill out the Decision 2 sheets; groups discuss and make their choices; these are marked on the sheets and turned in.
d. Each student completes a journal entry. Cards are replaced at bot toms of respective piles.

Day 5 Continue up the trail

Teacher Preparation: Have consequences of Decision 2 at hand (pp. 50-51), along with copies of Decision 3 worksheets.

Same format as Day 4

Day 6 End of the trail

Teacher preparation: Be prepared with consequences for Decision 3 (pp. 52-53), and with copies of Final Account Sheets (one per student or one per group —teacher's choice) and with Cattle Price Table (p.54).

a. Consequences of Decision 3.
b. Continue up the trail.
c. Each outfit, as they reach their destination, rolls the die to find out what price they will get for their herd.
d. Fill out Final Accounts (individually or as a class).
e. Complete journal and turn in.

NOTE: When the accounts are completed, the teacher should remind students that the profits for the trail drive go to the owner of the cattle, NOT to them (the cowboys). Their earnings are only about $1 per day (unless they were trail bosses, in which case they earned about $3 per day).

Journals

The student journal-keeping activity that is part of the Trail Drive Simulation can be done as simply or as elaborately as teachers wish. Students could be encouraged to create a "persona," perhaps inventing nicknames for themselves and giving some thought to their ages and backgrounds. (They may wish to name their favorite horses as well.) They can add as many details of daily life as they wish and create other incidents in addition to the ones described on their game cards.

Once the simulation is finished, editing and revising can be done following the guidelines of other writing projects. Students should be encouraged to aim for a document that has the right historical tone and a look of age and wear. (For example, misspellings might be left in to reflect a character's education level; use of capital letters to emphasize important words can indicate the historical period; paper could be "aged" to give it an authentic appearance.)

The following exerpts can be given (or read) to the class to give them some flavor of actual diaries of men who went "up the trail." George Duffield drove a herd from Texas to Iowa in 1866; Lewis W. Neatherlin went up the Western Trail to Nebraska in 1876.

from the diary of George Duffield, 1866 (as quoted in *Cowboy Culture* by David Dary)

May 13th: Big thunder storm last night. Stampede. Lost 100 beeves. Hunted all day. Found 50. All tired. Everything discouraging.

May 20: Rain poured down for 2 hours. Ground in a flood...Gloomey times as I ever saw.

May 31: [at the Red River] ...We worked all day in the river & at dusk got the last beefe over—& am now out of Texas—This day will long be remembered by me—There was one of our party drowned today (Mr. Carr) & several narrow escapes & I among the no. [number]

June 1: ...Horses <u>all</u> give out & men refused to do anything.

June 2ond: Hard rain & wind storm. Beeves ran & had to be on horse back all night. Awful night. Wet all night. Clear bright morning. Men still lost....Found our men with Indian guide and 195 beeves 14 miles from camp. Almost starved not having had a bite to eat for 60 hours....*Tired.*

June 14: ...We are now 25 miles from Ark [Arkansas] River & it is very high. We are water bound by two creeks & [nothing] but beef & flour to eat. Am not homesick but heart sick.

June 23: Worked all day hard in the river trying to make the beeves swim & did not get one over. Had to go back to prairie sick & discouraged. Have *not* got the *Blues* but am in *Hel of a fix*....

July 25th: We left the beefe road [cattle trail] & started due west across the wide prairie in the Indian Nation to try to go around Kansas and strike Iowa....

July 26th: ...the flies was worse than I ever saw them...

August 5th: Sunday. Travelled about 6 miles & are laying over washing & resting ourselves & stock. Saw a fine drove of antelope today. Splendid spring. ...going to turn north and trust to luck.

August 6th: ..Killed a fine lot of chickens [prairie chickens] & had a pot pie...

August 8th: ...cattle stampeded & ran by 2 farms & the people were very angry but we made it all right. Was visited by many men. Was threatened with the law but think we are all right now...

NOTE: Duffield finally reached Burlington, Iowa in early November.

from the journal of Lewis Warren Neatherlin, 1876 (edited by Leo Kelley, *Chronicles of Oklahoma,* Vol. LXVI, No. 1 [Spring, 1988], pp. 22-51)

Note: Neatherlin was the owner of 3 herds of cattle moving up the Western Trail to Ogallala, Nebraska, in 1876. He moved back and forth on the trail among the 3 herds, each of which was in the charge of its own trail boss.

March 16: Went to San Antonio for supplies and men. Got 5. Come back and met the herd at 6 Mile Branch....The cook borrowed a horse and saddle and went to town. Did not return.

March 26: Went on and found [herd] no. 1 on the Salado about 10 in the morning. The boss (Slaughter) about to get in trouble about having cattle in [our herd] that did not belong to him. I compromised with them by hiring one of their party to go with the herds [to] keep their cattle out. Started back to meet no. 2. Failed to meet it where I thought I would...I slept in the prairie without fire, grub or blankets, except my saddle blanket, but being very tired, I rested well.

April 5: A very cold norther blew up at 4 o'clock this morning. We made a 9-miles drive with nos. 1 and 2 and camped on Silver Creek. Grass a little better than last night. Swapped horses. Gave 2 for 1.

April 14: Did not drive today. Lay over to rest and graze the cattle. Lost 5 horses last night. I think they are stolen.

April 17: Nos. 2 and 3 crossed the San Saba today, making about 9 miles for no. 2 and 11 for no. 3....No. 1 is some 3 miles behind....Fine grass and plenty of prairie dogs.

April 24: ...I found 2 other cows, and...I commensed to drive the cows toward [the other men], and in running to keep them together, my horse put his foot in a prairie dog's hole and turned over with me, but I out-turned him and come out in the lead...Fine grass. Indications of a storm tonight. No. 1 got its wagon broke down on yesterday.

April 27: We started this morning but did not get more than a mile before the wagon broke down. I started out to swap for another and after riding till 3 in the evening, I swapped for one but very little better, but had 2 axles. I give 2 cows to boot. We did not make more than 2 miles. Still dry but indications of rain.

May 8: Started the herds on and went to the town to get the bill of yesterday's purchases and settle up. Found one man [cowboy] in town who had lost his horse and wanted 10 dollars. Did not get it. Also, another was in town last night and has not come out yet. Both rode horses in. I overtaken the herds as they were crossing the Clear Fork of the Brazos. We made 10 miles today.

May 9: The 2 men not come yet. I went back to hunt them, or rather, the horses. Met them coming. One asked me to go to town and redeem his pistol. He, having been a good hand, I did so. It took 10 dollars to get it. I returned and overtaken the herds at 4 in the evening. Made 9 or 10 miles. Good grass but very rocky and hilly.

May 14: Crossed the Big Wichita River. After crossing had some 5 or 6 miles of hilly salt-land, which was very difficult to drive over [as] every animal [wanted] to stop and lick or eat the salty dirt and weeds. A little rain just at dark. A man taken sick this morning.

May 24: More rain last night. Still raining slow this morning, with a strong wind from the north and disagreeable cool....Crossed 3 creeks. Do not know the name of any of them, but one thing I do know, they are troublesome to get the wagons over. Made some 10 miles.

May 26: ...We drove some 5 miles this afternoon over a beautiful, rolling prairie, but late in the evening we crossed the worst creek that we have seen. Had to unload the wagons, wading in soft mud to the knee to do it and broke one [wagon] tongue. Bogged about 20 cattle but got them all out except 2.

May 31: This morning I give directions for the herds to move on down the creek 5 miles and pull up for the day and rest, and wash saddle blankets. I took a lead horse and went back to the post [Camp Supply] to get flour and bacon to do us to Dodge. Returned late in the evening and found the herds at the crossing of Wolf Creek, 18 miles above the post...The post commander [had] issued orders for no herds to come nearer than 12 miles of the post under penalty of being arrested.

June 2: Being camped last night very near 2 herds that was ahead of us, we made a short drive today in order to let them get farther from us for, in case of bad weather as the clouds indicate, we might mix and that would be worse than laying up 2 days. A cool north wind today...coarse, rough grass, but fine water.

June 3: Rained last night and still raining this morning....Mr. Perry Thompson, just from Fort Griffin, overtaken us today. We were glad to see him as we get lonely in this country. Made a 12 miles drive and camped on a high, pretty prairie. No wood but plenty of buffalo chips. No water for the cattle today but fine grass.

June 14: Slaughter is sick today. I went out to the herd and cut and graded cattle. In running my horse, my pocketbook, containing $98.55 was lost and I have not found it at this time.

July 1: Cold norther blowing all day. Left 6 cattle; 4 from being poisoned, one from lameness and one from disease and old age. Crossed the state line and entered Nebraska...Drove 15 miles.

July 4: This being the one-hundredth anniversary of American independence, it seems as if we ought to have rest and amusement, but it was to the reverse with us, as I believe we have had hardest day's work that we have had on this trip. Drove 16 miles and ...could hardly see our

horses' ears for the dust, and the day very warm.

July 5: ...Grass very bad, almost none. Drove 10 miles.

July 8: The cook gave us a light breakfast owing to the wind blowing so hard that he could not cook well....We took a hearty dinner and drove 4 miles up the river valley to Ogallala, a small town on the Union Pacific Railroad, our destination.

Map Activities

1. Through what states does the Chisholm Trail pass?

2. If you followed the Goodnight-Loving Trail from Horsehead Crossing to Cheyenne, through which states and territories would you pass?

3. Follow the Western Trail from San Antonio to Fort Laramie. Write down each state or territory you move through.

4. The Jones-Plummer Trail begins at the Red River and ends at Dodge City. It passes through an area that is not part of any state or territory. What was that area called? What is it called now?

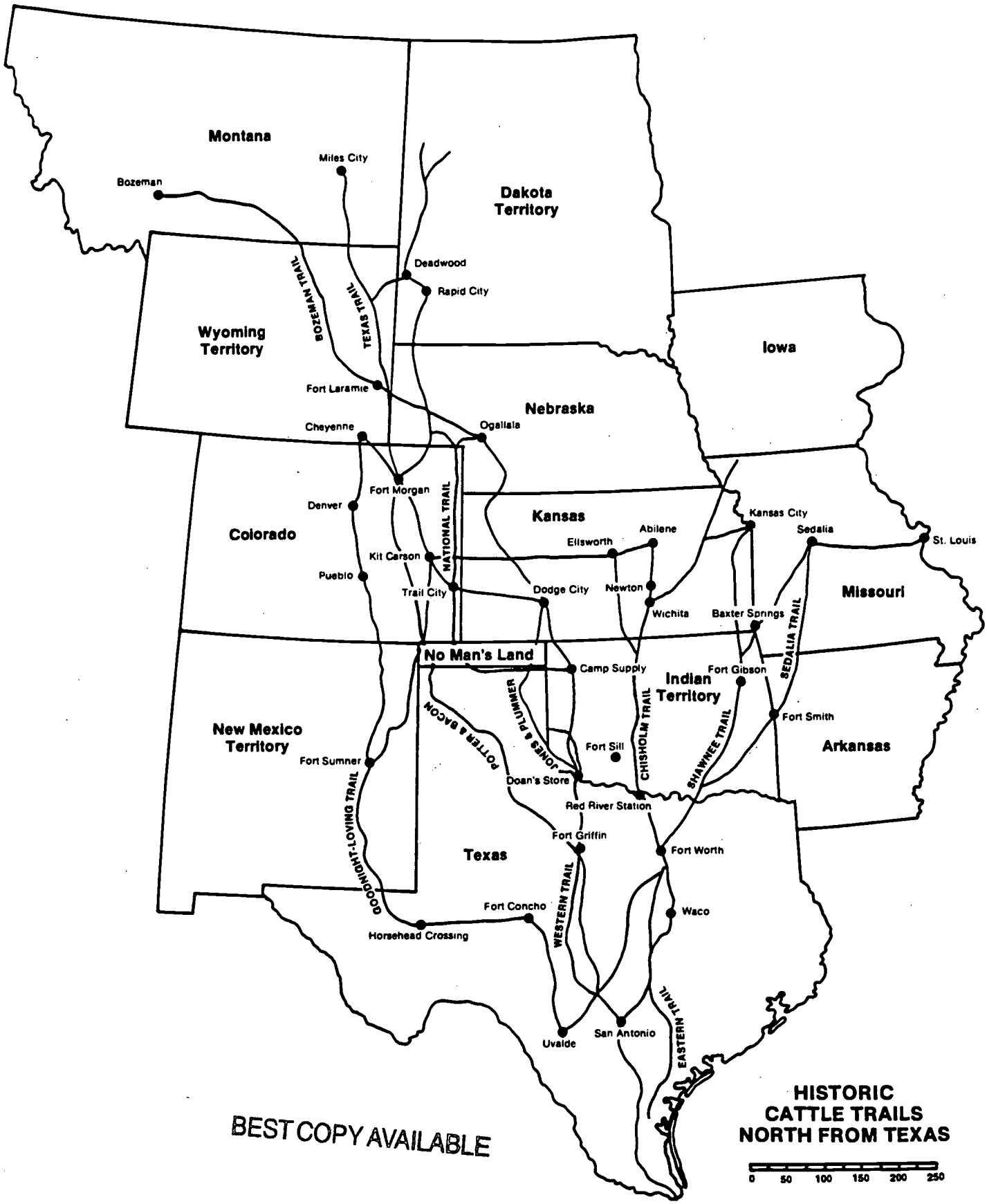
5. Plan a route from the southernmost tip of Texas to Bozeman, Montana. Write down the names of all the trails you would take. Using the scale of miles, calculate the approximate distance of your trip.

6. Plan a route from San Antonio to St. Louis. Write the names of all the trails you take.

7. Write the names of all the forts you find on the map. In which state or territory is each located?

FOR EXTRA CREDIT: Find out when each of the territories on the map became a state.

NAME_____



BEST COPY AVAILABLE

On the Trail

Trail Boss: the man in charge of the outfit. He was hired by the owner of the cattle to drive the herd to market. His job was to get the cattle to the railroad in the best possible condition, so he had to make certain the herd got enough grass and water along the trail. He made the decisions for the outfit such as how far to travel in a day, where to stop and bed down for the night, when and where to cross rivers, etc. He supervised the crew and was responsible for both cattle and cowboys.

Ramrod: the trail boss's "right hand man." Usually this cowboy would be a top hand, experienced and good at his job. The trail boss relied on him as second-in-command. The ramrod often was in charge of the outfit if the trail boss had to be away from the herd.

Cook: besides fixing 3 hot meals per day, the cook was responsible for driving the chuck wagon, and caring for it and for the mules which pulled it. He set up camp each night, and served as "doctor" if any men or horses were sick or injured. A good cook kept hot coffee going at all times. His disposition had a great effect on the outfit. Sometimes the cook was an older man, an ex-cowboy.

Wrangler: in charge of the remuda, or band of horses. Often the wrangler was a boy, the youngest of the crew. During the day he drove the horses and rounded them up as needed so the cowboys could change mounts. He found pasture for the horses at night. He also worked as the cook's helper.

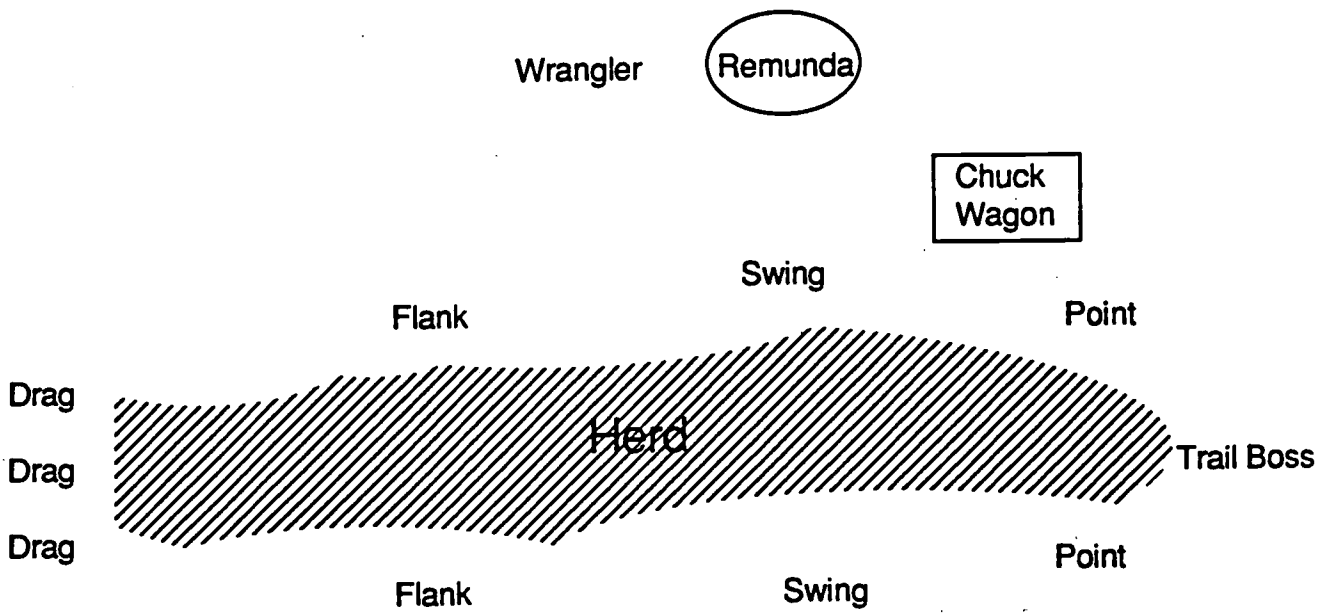
Cowboys: their jobs included driving the herd by day and guarding them by night. Each cowboy was responsible for a two-hour shift of night duty, circling the sleeping herd and keeping them settled and peaceful. Singing, humming or whistling softly had a calming effect on the cattle. The cowboys also doctored sick or injured cattle, made repairs on equipment as needed, branded strays, and generally did whatever jobs needed doing.



Drifting Before The Storm by Frederic Remington, 1904

Trail Positions

On the trail, the cowboys rode back and forth along the edges of the long, irregular line of cattle. They kept the cattle moving in the right direction and at a steady pace, chasing strays back into the line of march. The riders had certain positions, and each had its special function. **Point** riders rode at the front, pointed the herd in the right direction and set the pace. **Swing** and **flank** riders rode on either side of the herd and kept the cattle from wandering too far out. **Drag** riders rode behind the line of cattle and kept the slowest animals from straggling too far behind. Because of the dust stirred up by horses and cattle, drag was the most uncomfortable position. Most trail bosses tried to rotate positions so that no one had to ride drag all day.



The ramrod for each team will fill in the list below with names of the team members. This list will determine the order of turns during the game.

1. Trail boss_____
2. Point_____
3. Swing_____
4. Flank_____
5. Drag_____
6. Wrangler_____
7. (If more positions are needed, appoint a second point rider, second swing rider, etc.)

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Trail Drive Supplies

A cowboy travelled light. Besides the clothes he stood up in, he reported for work on the drive with a bedroll, slicker, chaps, saddle and saddle blanket, lariat, gun and holster and perhaps an extra shirt, socks and underwear. His gear was stored in the back of the chuck wagon.

The chuck wagon, in addition to providing work space for the cook, carried all the supplies for the entire crew. In the Trail Drive Game **every outfit will take the following supplies:**

wagon cover
corral and stake ropes
lantern
kerosene
shovel
branding irons
hobbles
bacon
coffee beans
pinto beans
salt
onions
lard
vinegar
sourdough starter
dutch ovens
coffeepot
tin plates, cups
matches
calomel
needle and thread
tobacco
rifle
extra ammunition
axle grease
water barrel (2 days' water)
ax
horseshoeing equipment
rods for pot rack
salt pork
flour
sugar
dried apples
raisins
baking soda
molasses
skillets
pot hooks
forks and spoons
knives
castor oil
bandages
razor, razor strop

EXTRAS: Each outfit chooses only two. Choose any <u>two</u> from the following and list them on your Trail Record: extra wagon wheel, extra rope, 4 extra cowboys, 20 extra horses, canned foods (tomatoes, peaches and milk), $500 in additional expense money.

Trail Record

	Expense Money	Cowboys	Horses	Cattle	Bonus Items
To Begin	$1,000.00	14	80	2000	
End of Session 1					
End of Session 2					
End of Session 3					
End of Session 4					

Name_____ 66

Brands

Cattle and horses were branded and marked to establish ownership. Brands could be made up of letters, numerals, shapes or designs and they were read (or "called") from top to bottom and from left to right. A cowboy often memorized hundreds of different brands, which were registered so that no two owners could use the same sign. Any person caught putting an unrecorded brand on an animal was subject to prosecution. (In some areas it was illegal to carry a "running iron" because it could be used to make any brand. Instead "stamp irons" were used. These made only a single brand.)

Brands were designed to be "called" easily. In addition, some owners tried to invent brands that were difficult to change, hoping to discourage rustlers.

Before starting "up the trail" in the Trail Drive Game, each outfit or team should choose or be assigned a brand. The name of the brand will also indicate the name of the outfit, such as the Walking R or the Bar Double Y. Several possibilities are listed below. (If time permits, the teams might be encouraged to come up with their own brands.)



Walking R



Bar Double Y



Rocking K



Running W



Turkey Track



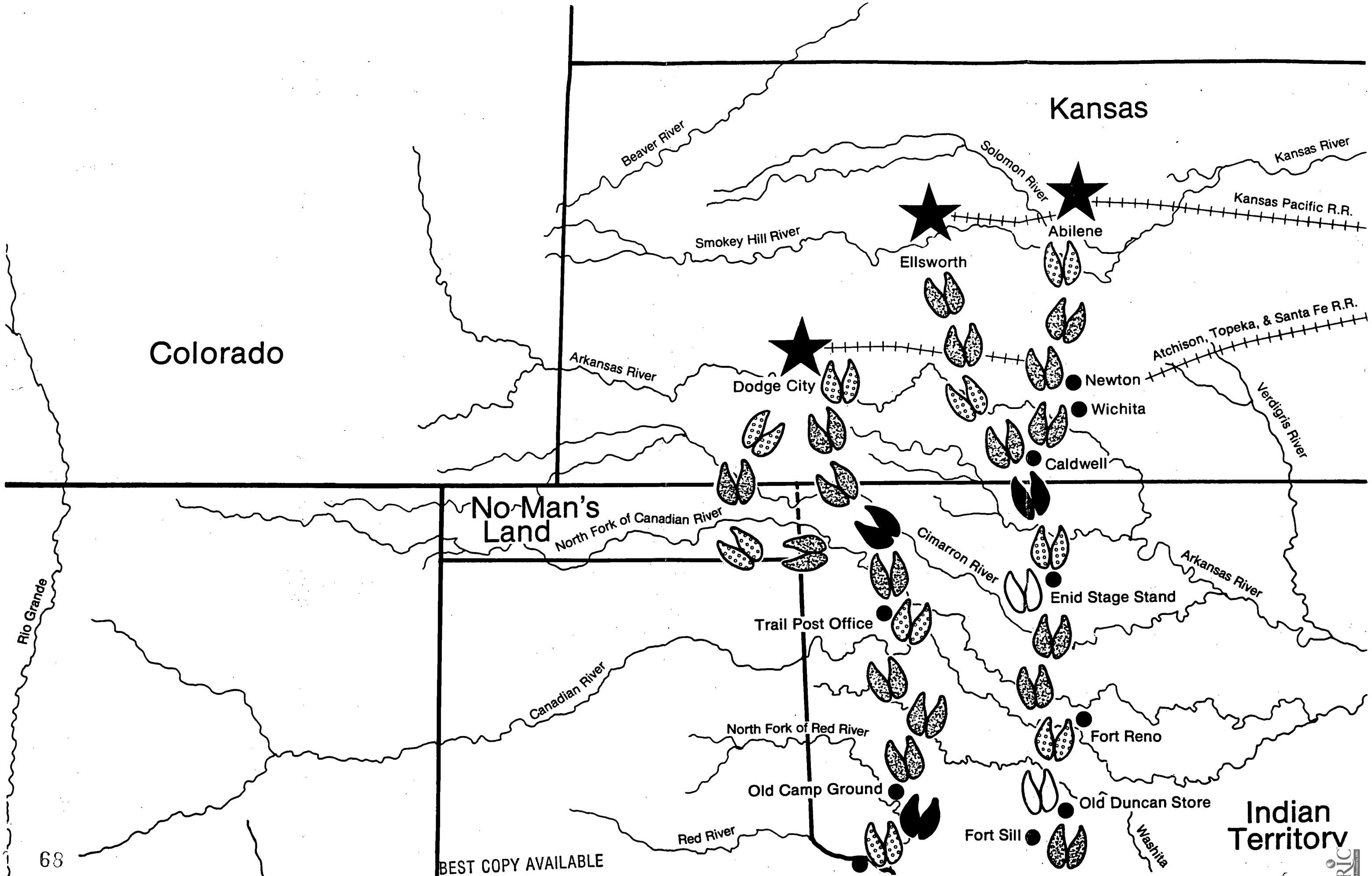
Circle C



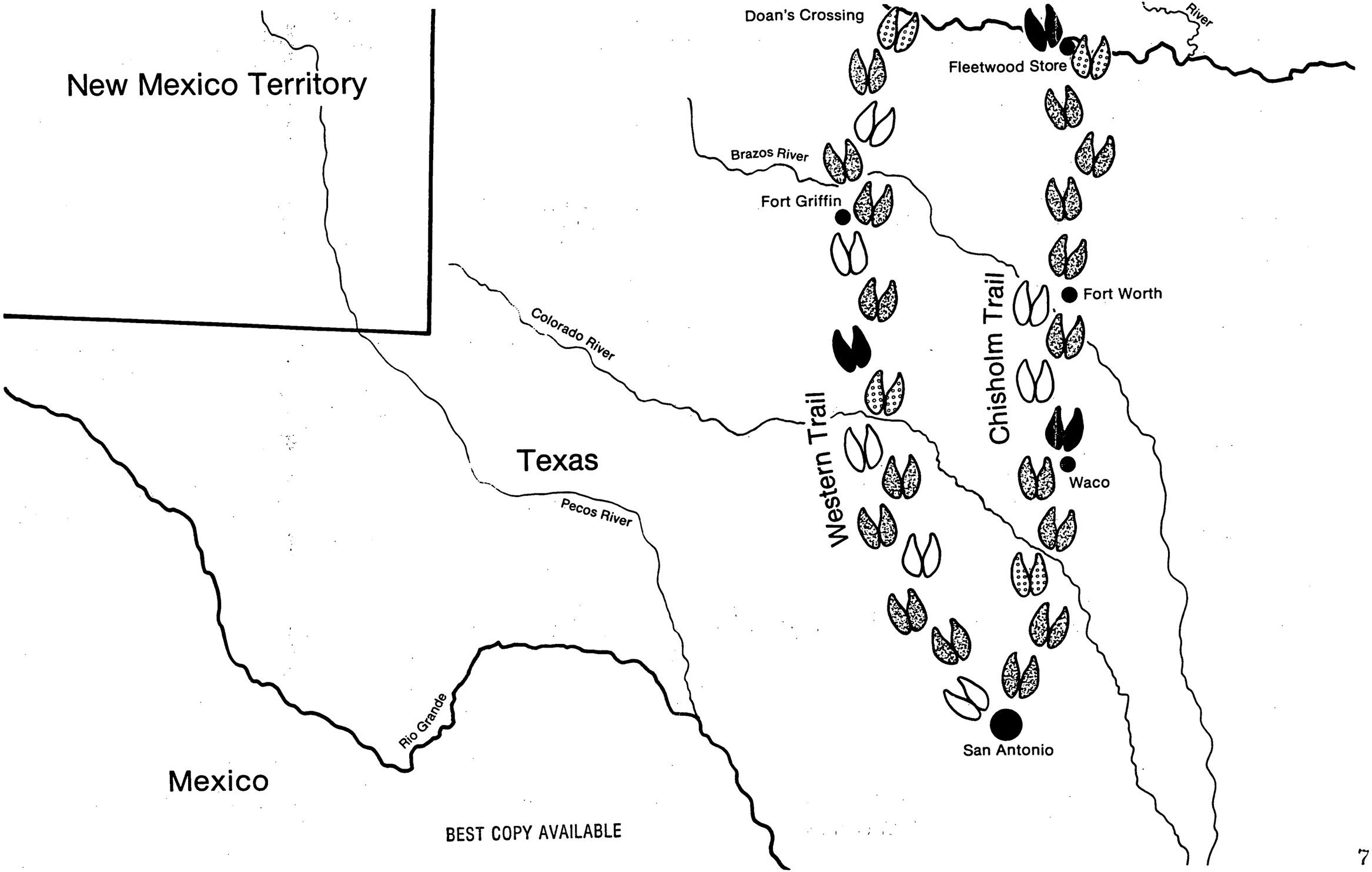
Flying Circle



Swinging Diamonds



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Cards - a.

Fate

One of your cowboys, a "greenhorn" (new to the job) finds the trail work too hard. He quits.

Deduct his pay ($20) from your expense money. Subtract one from your number of cowboys.

You must make a dry crossing. The trail boss decides to rest the cattle in the heat of the day, driving them only at night. This works until the third night, when the herd leaders finally smell water. Because they are frantic with thirst, they stampede. You and the other cowboys try to turn them, but nothing works. They reach the river at a bluff, and plunge over the edge. To everyone's amazement, only 4 cattle are lost. Your favorite night horse, however, has broken a leg and must be shot.

Subtract 4 from your herd tally. Subtract I from your remuda. Move off the trail to water and rest the cows. Stay there until you roll a 1.

Water has been scarce. The cattle are restless and hard to handle. Your trail boss sends you to search for a creek or spring where the herd can be watered. Roll the die.

Evens: You find a watering spot a short distance off the trail.
Odds: The water you find is so far away that several of the animals collapse. Subtract 5 head from your number of cattle.

Cattle inspectors want to check your herd for strays that show the brands of ranchers in the area. They find several, which must be cut out of the herd.

Stay in place until you roll a 2.

You count the herd and discover you've picked up 3 unbranded strays.

Add that number to your number of cattle.

Last night 2 other outfits were camped just ahead of you. Getting the herds mixed would be a big headache, so the trail boss orders a short drive today to let the others get further ahead.

Stay in place until you roll a 4.

You must make a dry crossing to reach water. The sun is blazing. People's lips crack and bleed from lack of moisture. Some of the herd panics and tries to turn back. You and the other cowboys work to keep the herd together, but you lose 6. The cattle go blind from thirst. Finally, after 3 days, you reach water.

Move off the trail to rest and graze the herd. Subtract 6 from your herd. Stay off the trail until you roll a 5.

The wheel of your chuck wagon is smashed beyond repair. If you brought an extra as one of your bonus items, you may move on. If not, send someone to the trail boss of the other outfit on your trail to see if they have an extra. If so, are they willing to trade it for some of your cattle? If you make the trade, they will add to their herd and you will subtract the agreed upon number of cows. If the trade can't be made, you must send someone to the nearest settlement for a wheel.

Stay in place until you roll a 2.

One of the men uses his spurs too roughly, even after being warned several times. The trail boss gives him his wages and sends him out of camp.

Subtract $25 dollars (his wages) from expense money, and subtract I cowboy from the total in your outfit.

A terrible thunderstorm stampedes the cattle during your watch. Roll the die.

Evens: You are able to turn the herd quickly and no cattle are lost. After the storm is over and the herd settled, however, you discover that one of the cowboys has been struck by lightning. Subtract I from your outfit and move off the trail while you bury him. (Until you roll a 4.)
Odds: The herd runs until dawn and exhausts itself. No cattle are lost, however.

Roll the die.

Evens: One of the cowboys in your outfit brags too much and interrupts other people's stories. After weeks of this everyone is irritable and grumpy. Sit and listen to him until you roll a 5.
Odds: One of the cowboys in your outfit is a terrific storyteller. He also makes up clever verses to add to everyone's favorite songs. Evenings around the campfire relaxing are relaxing and fun. Move ahead.

Wood for the campfire is hard to find in this area. The cook sends you to find some. Roll the die.

Evens: You find a creek with dead brush and trees from a recent flood.
Odds: You have no luck. Choose a friend to help you gather cow chips for the cook's fire. Gather them until you roll a 3.

Roll the die.

Evens: The cook catches some fish for dinner. The change in fare puts everyone in good mood.
Odds: The cook is tired of being teased about his cooking. At supper tonight the biscuits are burned, the beef is raw and the coffee is weak. Everyone is in a rotten mood. Stay in place until you roll a 4.

You are sent ahead to look for a place to water the herd. Roll the die.

Evens: There's a creek ahead, but homesteader's fields are nearby and there are no fences to keep cattle off the crops. Stay in place until you roll a 2.
Odds: You find an excellent place to water the herd.

You find a nest of turkey eggs, and the cook fixes them for breakfast. There are enough for each cowboy to have one, and everyone is happy for the change in diet. There is one extra egg. All members of your outfit roll the die. The person with the highest number gets the extra egg.

The grass in this area is lush and green. The trail boss decides to move off the trail to graze and fatten the cattle.

Move off the trail until you roll a 6.

Wild mustangs charge through your herd, scattering them. Three of your horses run off with them. Subtract 3 from your remuda and stay in place to round up the herd (until you roll a 2).

You find 4 unbranded strays with your herd. Add that number to your herd total.

A sudden thunderstorm stampedes your cattle. There are two other herds close by on the trail and they stampede as well. The cattle run until they are exhausted, and then you and the other outfits have the huge job of sorting out the 3 mixed up herds.

Stay in place until you roll a 3 and a 5.

Two people from another outfit ride into camp at supper time. They stay for a meal and sit for awhile around the campfire. Everyone is glad to see new faces and hear new stories.

During the night, wolves move in and frighten the herd. They stampede. Your night horse steps in a prairie dog hole and goes down. You are thrown clear of the herd and are not hurt, but your horse's leg is broken. He must be shot. Subtract I from your remuda. Roll the die.

Evens: No cattle were lost.
Odds: 2 head are lost. Subtract that number from your herd total.

You get sick from drinking bad water. Miss your next turn.

One of the cowboys in your outfit ropes a stray, but catches his finger between the rope and the saddlehorn. The steer pulls on the rope and the cowboy's finger is cut off. He must ride in the wagon until he recovers. You lose 4 cattle because you are shorthanded.

Stay in place until you roll a 3 and a 4.

While collecting cow chips for the cook's fire you are stung by a scorpion. Stay in place until you roll a 3.

Everyone is tired and discouraged. If you brought canned tomatoes, peaches and milk as part of your bonus supplies, have the cook fix a special meal to cheer everyone up.

If you did not, stay in place, eating the same old menu, until you roll a 6 and a 4.

Cold rains leave everyone miserable. One of the cowboys in your outfit comes down with pneumonia. Roll the die.

Evens: He dies. Subtract 1 from your number of cowboys. Bury him and move off the trail until you roll a 2.
Odds: He recovers.

Rustlers steal 22 cattle from your herd, and 5 horses from your remuda. Subtract those numbers from your totals.

The herd drinks water contaminated with poisonous gypsum. You lose 100 head. Subtract that number from your herd total.

A prairie fire scatters the herd. One cowboy is seriously burned. Stay in place to round up the herd and to apply first aid (until you roll a 1).

Stray cattle wander into your herd. Roll the die.

Evens: Add 10 to your herd total.
Odds: Add 20 to your herd total.

Your cook quits. Move off the trail while the trail boss rides into the nearest town to try to hire another one. (Stay in place until you roll a 6). Roll the die again to find out what kind of cook he was able to hire.

1 or 2: You've got a great cook, but he's very easily irritated. Everyone will have to be careful around him so he won't quit also.
3 or 4: The only man willing to hire on is a rotten cook with an even worse temper. This will make the rest of the drive even harder.
5 or 6: This man cooks pretty well, believes in serving plenty of food, and never lets the coffee pot run dry. He goes out of his way to try to come up with special treats for your outfit. He will make life more pleasant on the drive.

Cattle inspectors want to check the brands on your herd. Roll the die.

Evens: You learn later that these men weren't inspectors. They were rustlers, who cut 20 strays out of your herd. Subtract from your total.
Odds: You recognize one of the men as a rustler and warn the boss. He refuses to allow them to inspect, and posts extra guards that night in case they come back.

At 2:30 in the morning, rustlers stampede your cattle, hoping to be able to use the confusion as a cover while they steal from your herd. Roll the die.

Evens: The cattle run for miles and the herd is scattered across the prarie before they can be turned. One cowboy is killed. Move off the trail while you bury him. Roll the die again to see how many cows are lost. Subtract from your total of cattle and people.
Odds: Quick action on the part of your outfit turns the herd and stops the stampede. No cattle are lost.

River Cards 9.

Herds are backed up at the river crossing. Stay in place until you roll a 5.

The river crossing goes smoothly for awhile. Suddenly, some of the cattle panic and try to climb over the ones in front of them. You are knocked off your horse in mid-river, but are able to grab his tail. He swims safely to shore, towing you. Roll the die to see how many cattle are lost. Subtract that number from your herd total.

The river is up and is running fast. More than half the herd is across safely when one of the horses gets tangled in submerged branches. His rider does not know how to swim. Before anyone can get to them, both horse and rider are drowned. (Subtract I from your number of cowboys and I from your remuda.)

The river is in flood. After waiting 3 days for it to go down, your trail boss decides to risk the crossing. Roll the die.

Evens: The cattle are swept downstream by the swift current and are spread out for two miles along the opposite bank of the river as they climb out. Your best swimming horse performs beautifully and no cattle are lost. It takes quite a while to round up the herd on the far side of the river, however. Stay in place until you roll a 5.

Odds: The cattle are swept downstream by the current. They panic and try to climb over the backs of those in front of them. Three are drowned. Subtract that number from your herd total.

Although the river is unusually deep for this time of year, the crossing goes very well. The cook makes a special meal to celebrate.

Your lead cattle take to the river without any problems. Cowboys and horses perform beautifully and the crossing goes smoothly.

The approach to the river appears dry and solid. However, as you start moving the cattle across, you discover that dry sand has blown across several boggy places. Three cows are stuck and must be pulled from the mud.

If you brought along extra rope, stay in place until you roll a 1.

If you have no extra rope, stay in place until you roll a I and a 3.

The lead cattle move into the river without hesitating. They are nearly across when two and then three more begin bawling. They are caught in quicksand. The swing and flank riders move quickly to try to turn the rest of the herd away to firmer ground. Their quick thinking pays off, and you are left with only 5 bogged cattle to pull out.

If you have extra rope as one of your bonus items, stay in place until you roll a 6.

If you don't have extra rope, stay in place until you roll a 6 and a 3.

Two cattle bog in quicksand during the river crossing. Roll the die.

Evens: After hours of work to free one of the steers, you and another cowboy finally pull him clear. He is angry and charges you, and you are thrown from your horse. Miss your next turn.

Odds: After hours of work, one steer is freed and the second one is ready to be pulled out. You and another cowboy move your horses forward to pull on the ropes looped under the bogged steer's legs. The steer pulls free, but one of the ropes has slipped, and the steer's body is ripped from the leg, which is still stuck in the mud. Subtract one from your herd total.

The river is swollen with flood waters and moving fast. Your trail boss feels too much time has already been lost, and doesn't want to wait for the waters to go down. The chuckwagon overturns in the rushing waters and is smashed against a rock. Fortunately the cook and the mules are saved.

Move off the trail while the cook goes to the nearest town to have the wagon repaired and to buy supplies to replace those that were lost. Deduct $350 from your expense money. (If you do not have enough, sell cattle at $20 per head to pay your bills, and deduct the number you sell from your herd total.) Stay off the trail until you roll a 4.

9.

The river crossing is going smoothly until one steer sees a floating log and panics. You lose 7 head to drowning. Subtract that number from your herd total.

Congratulations! This river crossing is one of the smoothest any cowboy in your outfit has ever seen!

Trail Drive Decision 1: Chisholm Trail

The local sheriff rides into camp and asks to see the trail boss. The sheriff says that farmers in the area claim that your herd has damaged their crops. The sheriff plans to assess the damage and you will have to pay a fine.

Directions: Read each Possible Action carefully. In the space provided, analyze what may happen if you take that action. Tell whether or not you favor the action. Explain why. If you can think of a better action to take, write it in the ANOTHER ACTION box. Then analyze it as you did the others. After you meet with the other members of your outfit and discuss the possible actions, circle the action which is decided upon by the group.

POSSIBLE ACTIONS	ANALYSIS OF POSSIBLE ACTIONS
1 . The trail boss says the farmers shouldn't be homesteading on prime grass land. They should leave Texas and go back East where they belong. The longer he talks, the angrier he gets. He finally refuses to pay any fine.	
2 . The trail boss agrees to pay the fine.	
3 . Your outfit is certain that your herd caused no damage to any fields in the area. The trail boss offers to go with the sheriff to talk to the farmers involved and to help figure out which herds did the damage.	
4. Another possible action	

Trail Drive Decision 1: Western Trail

A dry spring in this section of Texas has left water in short supply. The cattle are thirsty and hard to handle, but one of your hands knows of a water hole only a short distance off the trail. When you get there, however, you discover that a farmer has claimed the land as a homestead and says the water is now his private property. He and his sons will defend it with guns if necessary.

Directions: Read each Possible Action carefully. In the space provided, analyze what may happen if you take that action. Tell whether or not you favor the action. Explain why. If you can think of a better action to take, write it in the ANOTHER ACTION box. Then analyze it as you did the others. After you meet with the other members of your outfit and discuss the possible actions, write which action is decided upon by the group.

POSSIBLE ACTIONS	ANALYSIS OF POSSIBLE ACTIONS
1 The grass and water in this part of Texas have always been free. Many in your outfit are angry that settlers are beginning to move in and plow up the grasslands. Now they are trying to keep thirsty men and cattle from water. This is serious business on the arid plains. Arguing turns to shouting. Finally the trail boss tells the farmers to move aside. The cowboys outnumber the farmers, and the boss is betting that they won't really fight against such uneven odds.	
2 The trail boss and others explain that there's no other water to be found in the area. The farmers know this, but say they need this water for their own stock. After some discussion with other members of the outfit, the trail boss asks the farmers if they would be willing to accept money for water.	
3 No amount of arguing will change the farmers' minds. They allow the cowboys to fill their canteens, but say that's all the water they can spare. With reluctance, the trail boss gives the order to move on. Two scouts are sent out to search for another place to water.	
4 Another possible action	

Trail Drive Decision 2: Chisholm Trail

You cross the Red River into Indian Territory. You are now in the Chickasaw Nation. Inspectors greet you with the news that the Chickasaw Nation is now charging a toll fee of 15 cents per head to cross their lands. Furthermore, you must agree to stay on the trail, to move at least 8 miles per day, and to allow grazing only on a strip a mile wide on either side of the trail.

POSSIBLE ACTIONS	ANALYSIS OF EACH ACTION
1 The new regulations are a surprise, but the land does belong to the Indians and you think they have a right to charge tolls. Many of them are ranchers themselves, and they are tired of Texas cattle eating all their grass. Your trail boss agrees to follow the new rules. Multiply the number of cattle in your herd by $.15 and pay the toll fee. (Subtract that amount from your expense money.)	
2 These rules have never been mentioned before and there is much grumbling among your outfit. You think the Indians have no right to charge tolls or make trail rules. Still, the trail boss does not want trouble, so he pays the fees. However, he takes a chance that the inspectors will not take time for an accurate count, and he gives a herd tally that is 200 less than the actual number. (Subtract 200 from your herd count. Multiply that number by $.15, and subtract the answer from your expense money.)	
3 Your trail boss decides to pay the toll without grumbling, but once he gets out of sight of the inspectors he turns the cattle out to graze. He plans to fatten the herd on the Indians' grass (beyond the 1 mile limit). He thinks this will raise the price he will get for the cattle and will make up for the unexpected expense of the toll charge. (Multiply the number in your herd by $.15 and subtract that answer from expense money.)	
4 Another possible action	

Trail Drive Decision 2: Western Trail

You cross the north fork of the Red River into Comanche territory. A band of Comanches meets you and asks for 12 head of cattle in exchange for safe passage through their country. They explain that they need food for their people because the government rations are late in coming and often aren't enough when they do arrive.

POSSIBLE ACTIONS	ANALYSIS OF POSSIBLE ACTIONS
1 Your trail boss is willing to negotiate with the Comanches but does not want to part with 12 head of cattle. He talks with the leader of the group to try to persuade him to accept a smaller number.	
2 Your trail boss knows the Comanches may try to stampede the cattle if their demands aren't met. He agrees to give them the 12 cattle they asked for.	
3 Your trail boss says he will not pay blackmail, and that he will shoot any Indians who try to stampede his herd.	
4 Another possible action	

Trail Drive Decision 3: Chisholm Trail

At the Kansas border, you are met by armed settlers. They are upset because the herds coming up the trail have brought Texas fever to their cattle. The disease is killing their stock, and they are unwilling to let any more Texas herds pass through their area until winter (when the fever doesn't seem to spread).

POSSIBLE ACTION	ANALYSIS OF POSSIBLE ACTION
1 You could agree to hold your herd in place until cold weather. If you do this, however, you will have to pay grazing fees to the Cherokees while you wait in Indian Territory. Also, you will have to pay your outfit for at least two months more work while they hold the herd.	
2 You could tell the farmers that you need time to decide, and then try to drive the herd through at night. Perhaps you can get beyond their farms before they realize what's happened.	
3 You could take another route to reach the railroad, and end up at Ellsworth instead of Abilene.	
4 Another possible action	83

Trail Drive Decision 3: Western Trail

As you get close to the Kansas border, you hear rumors that armed farmers are trying to keep herds from using the trail. They say the cattle are bringing Texas fever into Kansas, and that it is killing their stock. You must decide whether to continue straight up the trail or to take a branch through No Man's Land, which will avoid the settled parts of Kansas.

POSSIBLE ACTIONS	ANALYSIS OF POSSIBLE ACTIONS
1 You decide to move to the west and go through No Man's Land (where you will be on the Jones-Plummer Trail).	
2 You decide to take your chances with the farmers and continue straight up the trail. Perhaps the rumors are not true.	
3 Another possible action	

Chisholm Trail: Decision 1

The local sheriff rides into camp and asks to see the trail boss. The sheriff says that farmers in the area claim that your herd has damaged their crops. The sheriff plans to assess the damage and you will have to pay fines.

OPTIONS	CONSEQUENCES
OPTION 1: The trail boss says the farmers shouldn't be homesteading on prime grass land and they should leave Texas and go back East. The longer he talks, the angrier he gets. He finally refuses to pay any fines at all.	OPTION 1: The sheriff throws the trail boss in jail. He impounds the herd, which means it cannot move on. Move off the trail. Stay there until you roll a 6 and a 2. Pay $600 in fines for the damage, and $50 bail for your trail boss.
OPTION 2: Your trail boss agrees to pay the fine.	OPTION 2: Roll the die to find out how many hundred dollars you must pay in fines. Subtract that amount from your expense money.
OPTION 3: Your outfit is certain that your herd has caused no damage to any fields in the area. The trail boss offers to go with the sheriff to talk to the farmers involved and to help try to figure out whose herds did the damage.	OPTION 3: The sheriff agrees to go with the trail boss to talk to the farmers involved. **Roll the die.** **Evens:** By figuring out when the damage occurred, the trail boss is able to prove that your herd couldn't have caused the problem. The sheriff gives permission for your outfit to continue up the trail. **Odds:** Your trail boss cannot convince the farmers that your herd didn't cause the damage. The sheriff says you must pay $600.00 in fines. Subtract that amount from your expense money.

Western Trail: Decision 1

A dry spring in this section of Texas has left water in short supply. The cattle are thirsty and hard to handle, but one of your hands knows of a water hole only a short distance off the trail. When you get there, however, you discover that a farmer has claimed the land as a homestead and says the water is now his private property. He and his sons will defend it with guns if necessary.

DECISION 1	CONSEQUENCES
OPTION 1: The grass and water in this part of Texas has always been free. Many in your outfit are angry that settlers are beginning to move in and plow up the grasslands. Now they are trying to keep thirsty men and cattle from water. This is serious business on the arid plains. Arguing turns to shouting and finally the trail boss tells the farmers to move aside. The cowboys outnumber the farmers, and the trail boss is betting that they won't really fight against such uneven odds.	OPTION 1: **Roll the die.** **Evens:** In a gun battle over the water, the farmer is wounded and one of his sons is killed. One cowboy and 2 horses are killed. The farmer and his other two sons give up, but the cattle have been panicked by the noise, and 3 are lost. Finally the herd is watered, but now you must push extra hard to get out of Texas because the sheriff will be after you because of the dead boy. (Subtract 1 cowboy, 2 horses and 3 cattle from your totals.) **Odds:** The farmers give up without a fight. The herd is watered and you move back to the trail. That night, however, the herd stampedes. Twelve cattle are lost. Many of the cowboys believe the farmers caused the stampede, although there's no way to prove it. (Subtract 12 from your herd total.)
OPTION 2: The trail boss and others in the outfit explain that there's no other water to be found in the area. The farmers know this, but say they need this water for their own stock. After some discussion with other members of the outfit, the trail boss asks the farmers if they would be willing to accept money in return for water.	OPTION 2: The farmer agrees to accept a watering fee. He wants 25 cents per head. The trail boss says that is too high, and offers to pay 10 cents. **Roll the die.** **Evens:** A compromise is reached. Pay 15 cents per head from your expense money. **Odds:** The farmer stands firm. Pay 25 cents per head.
OPTION 3: No amount of arguing will change the farmers' minds. They do allow the cowboys to refill their canteens, but say that's all the water they can spare. Reluctantly, the trail boss gives the order to move on. Two scouts are sent out to search for another place to water.	OPTION 3: Scouts return to report that the nearest water is 80 miles away. **Roll the die.** **Evens:** The blazing sun is a misery for men and animals. Three of the weak cattle die on the way, but the rest of the herd makes it. Subtract 3 from your herd total. **Odds:** More than halfway to the water, some of the herd tries to turn back. They scatter over the prairie, and by the time the cowboys can get them back under control, 14 have been lost. Subtract 14 from your herd.

Chisholm Trail: Decision 2

You cross the Red River into Indian Territory. Chickasaw inspectors greet you with the news that the Chickasaw Nation is now charging a toll fee of 15 cents per head to cross their lands. You must stay on the trail, move at least 8 miles per day, and allow grazing only on a strip a mile wide on either side of the trail.

OPTIONS	CONSEQUENCES
OPTION 1: The new regulations are a surprise, but the land does belong to the Indians and they have a right to charge tolls. Many of them are ranchers themselves, and they are tired of their grass being over-grazed by Texas cattle. Your trail boss agrees to follow the rules. Multiply the number of cattle in your herd by 15 cents each and pay the toll fee. (Deduct that amount from your expense money.)	OPTION 1: Your cooperation is repaid. Local ranchers and hands assist your outfit as much as possible as you pass through the Chickasaw Nation. (When you draw your next Fate card with a possible bad outcome, you may take the best result without rolling the die.)
OPTION 2: These rules have never been mentioned before and there is much grumbling among your outfit. Several think the Indians have no right to charge tolls or make trail rules. Still, the trail boss does not want trouble, so he agrees to pay the fees. However, he takes a chance that the inspectors will not take the time for an accurate count and he gives a tally that is 200 less than the actual number. (Subtract 200 from your herd count, multiply that number by $ .15 and subtract the amount from your expense money.)	OPTION 2: **Roll the die.** **Evens:** The inspectors are too busy to take an accurate count. Move ahead on the trail. **Odds:** The inspectors count accurately and discover your tally is low by 200 head. Multiply 200 by $.15 and subtract the total from your expense money.
OPTION 3: Your trail boss decides to pay the toll without grumbling, but further up the trail, out of sight of the inspectors, he turns the cattle out to graze. By violating the one mile regulation, he plans to fatten the herd on Chickasaw grass. He thinks this will raise the price he will get for the cattle and will make up for the unexpected expense of the toll charge. (Multiply the number in your herd by $ .15 and subtract that amount from your expense money.)	OPTION 3: **Roll the die.** **Evens:** After warning your trail boss, local ranchers complain to inspectors that your herd is grazing outside the 1 mile limit. Your outfit is fined $1.00 per head. Multiply the number in your herd by $1.00 and subtract the total from your expense money. If you do not have enough expense money, pay with cattle. A price of $20 per head is agreed upon. How many head will you have to give up to pay your fine? Subtract that number from the total in your herd. **Odds:** Local ranchers warn the trail boss about the heavy fines for grazing outside the limits. He decides it is not worth the risk, and moves the herd on.

Western Trail: Decision 2

You cross the north fork of the Red River into Comanche territory. A band of Comanches meets you and asks for 12 head of cattle in exchange for safe passage through their country. They explain that they need food for their people because the government rations are late in coming and often aren't enough when they do arrive.

OPTIONS	CONSEQUENCES
OPTION 1: Your trail boss is willing to negotiate with the Comanches but does not want to part with 12 head of cattle. He talks with the leader of the group to try to persuade him to accept a smaller number.	OPTION 1: Roll the die twice to find the number of cattle you must give the Comanches. Subtract that number from your herd total. (Trail bosses usually gave up weak or sick cattle or strays in this kind of situation.)
OPTION 2: Your trail boss knows the Comanches may try to stampede the cattle if their demands aren't met. He agrees to give them the cattle they ask for. Subtract 12 from your herd total.	OPTION 2: Only a few miles up the trail, another band of Comanches demands more beef. **Roll the die.** **Evens:** This time the trail boss negotiates. Roll the die again to see how many beef you must give up. Subtract that number from your herd total. (Trail bosses usually gave up weak or sick cattle or strays.) **Odds:** Your trail boss refuses to give up any more cattle. That night, your herd stampedes. One cowboy is killed. Roll the die to see how many cattle are lost. Subtract from your total number of hands and of cattle.
OPTION 3: Your trail boss says he will not pay blackmail, and that he will shoot on sight any Indians who try to stampede his herd.	OPTION 3: That night your herd stampedes. One cowboy is killed. **Roll the die twice** to find out how many cattle are lost. Subtract from your total number of hands and of cattle.

Chisholm Trail: Decision 3

At the Kansas border, you are met by armed settlers. They are upset because the herds coming up the trail have brought Texas fever to their cattle. The disease is killing their stock, and they are unwilling to let any more Texas herds pass through their area until winter (when the fever doesn't seem to spread).

OPTIONS	CONSEQUENCES
OPTION 1: You could agree to hold your herd in place until cold weather. If you do this however, you will have to pay grazing fees to the Cherokees while you wait in Indian Territory. Also, you will have to pay your cowboys for at least two more months of work while they hold the herd.	OPTION 1: Pay grazing fees of $1.00 per head to the Cherokees. (If you do not have enough expense money left, you may pay with beef. At $20 per head, sell enough cattle to the Indians to pay your bill. Adjust your trail record accordingly.) When you get to Abilene, remember to pay all your hands for 5 months work instead of for 3 months.
OPTION 2: You could tell the farmers that you need time to decide what to do, and then try to drive the herd through at night. Perhaps you can get beyond their farms before they realize what's happened.	OPTION 2: The settlers expected such a trick, and they had posted guards along the trail. They block the trail. Someone fires a shot, and a gun battle follows. Your outfit loses 3 men and 30 cattle. Subtract those numbers from your trail record. Continue up the trail to Ellsworth instead of to Abilene.
OPTION 3: You can take another route to the railroad, and end up at Ellsworth instead of at Abilene.	OPTION 3: Continue up the trail toward Ellsworth.

Western Trail: Decision 3

As you get close to the Kansas border, you hear rumors that armed farmers are trying to keep herds from using the trail. They say the cattle are bringing Texas fever into Kansas, and that it is killing their stock. You must decide whether to continue straight up the trail or to take a branch out through No Man's Land which will avoid the settled parts of Kansas.

OPTIONS	CONSEQUENCES
OPTION 1: You decide to move to the west and go through No Man's Land (where you will be on the Jones-Plummer Trail).	OPTION 1: Outlaws hiding out in this lawless territory attack your outfit. Their leader was a member of the famous Coe Gang, whose hideout (called Robbers' Roost) in northwestern No Man's Land was cleaned out by the U.S. Marshalls several years ago. Two of the men escaped and have formed a new gang. **Roll the die.** **Evens:** You fight them off successfully without losing any men or cattle. **Odds:** Your outfit finally drives them away, but only after 1 cowboy is killed. Subtract 1 from your number of cowboys.
OPTION 2: You decide to take your chances with the farmers and continue straight up the trail. Perhaps the rumors are not true.	OPTION 2: You reach the Kansas border. **Roll the die.** **Evens:** The rumors were true, and the trail is blocked by a group of angry farmers. They absolutely refuse to let the herd pass. Turn west and head for No Man's Land. **Odds:** You meet with no problems at all at the border. Continue up the trail to Dodge City.

CATTLE PRICE TABLE*	
Die Roll	Result
1	Price war between competing railroads lowers shipping costs. You receive $40 per head.
2	More buyers than sellers. $35 per head
3	Shortage of cattle for sale. $30 per head
4	More sellers than buyers. $20 per head
5	Your cattle are weak and underfed. $15 per head
6	Railroads agree on high shipping rates. $10 per head

*Adapted from *The Chisholm Trail Game* by Herschell M. Sarnoff

Final Account

1. Roll the die to find out the price per head you are able to get for your cattle. How will you find out the total amount of money you've made?

   TOTAL RECEIVED FOR CATTLE:_____

2. Now you must figure in your trail expenses. Add the amount of expense money you have left to the amount you received for your herd. Then subtract the total amount of expense money you started with.

   TOTAL AFTER TRAIL EXPENSES:_____

3. Now you must pay wages. The trail boss receives $90 per month for 3 months (or for 5 months if that was the consequence of one of your decisions).

   WAGES (TRAIL BOSS)_____

   The cook receives $60 per month.

   WAGES (COOK)_____

   The cowboys each receive $30 per month.

   WAGES (COWBOYS)_____

   The wrangler receives $25 per month.

   WAGES (WRANGLER)_____

   Calculate the final total of all the wages you must pay your outfit.

   FINAL TOTAL (WAGES)_____

4. Subtract the final total of all wages from the amount received for the herd after expenses. (See number 2.) This is the amount the trail boss is to deliver to the owner.

   TRAIL DRIVE PROFIT_____

NAME_____

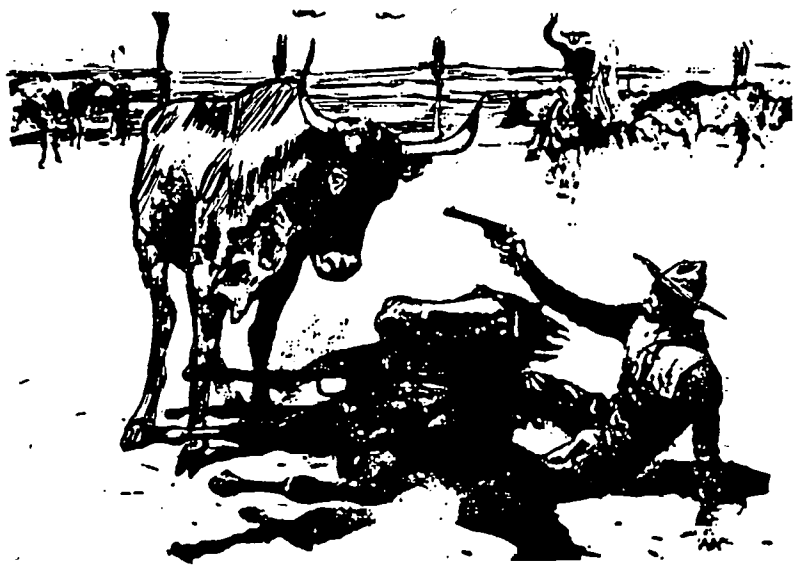
Souvenir Photographs

When trail-driving outfits reached their destinations, they often went to the photographer's studio for a souvenir picture. On the last day of the Trail Drive Game bring a camera to class and photograph each outfit (costumes optional).

Story Problems

As an optional further activity involving language arts, social studies and math, have students write story problems based on the historical background they have learned about cowboys and cattle trails. Directions can be given so that specific skills are emphasized. For example, a teacher might require that each student write 4 problems, 2 involving multiplication and 2 involving division. A further requirement might be that at least one problem have two steps.

Students should solve their own problems to provide an answer key. Then a sheet of problems compiled from those written by students can be used with the entire class.



A Critical Moment by Frederic Remington, 1902

CHUCKWAGON COOKING

At a roundup at the home ranch, or on a 5 month trail drive that covered 1500 miles, the chuck wagon was the most important piece of equipment in the cattle industry, and the cook was the most important person. More than any other man, the cook ensured the cowboys were happy and productive. Without good food, men would quit and the work would not get done.

Cattleman Charles Goodnight in 1866 took a surplus army wagon, made a few changes to it and developed the first modern chuck wagon. Its most distinctive feature was the chuck box, a 4' by 3' box two to three feet deep, which was placed on the rear of the wagon. A board, hinged at the bottom of the box, folded down to form a work table. The box was divided into cubbyholes and drawers for small amounts of food, medicines, eating utensils, cooking equipment, tobacco and maybe whiskey. Other supplies on the wagon would be a Dutch oven, skillets, a water barrel, flour, horseshoeing supplies, branding irons, tools and bedrolls. Just about everything needed to care for the cowboys and animals could be found inside the chuckwagon.

The cook was king of the chuck wagon and 60 feet around it, an area where his word was law, and woe unto any cowboy crossing the line or breaking any of 'Cookie's' rules. In addition to making three meals a day for up to 30 men, the cook also served as camp barber, banker, doctor, dentist, referee, launderer, repairman, gravedigger, teamster and seamstress. His background ranged from that of a broken-down cowboy, horse thief or city slicker.

Hard work and long days meant the men needed good food and plenty of it. A typical breakfast was beef, hot bread, dried fruit and coffee. The noon meal was often roast beef, beans, potatoes, gravy, bread or sourdough biscuits, coffee and dessert. At night there was deep fried beef steak, short ribs cooked with onions and dessert.

The cook was usually the first man up in the morning and the last to bed down at night. Coffee was on the fire at all times, because the cowboys watched the herd in shifts, and the lonely fellow who got night duty needed lots of strong, hot coffee to keep him alert. The cowboys were paid an average of $1 day for their work; however, the cook received nearly double that rate. The reasoning was that good food was going to draw good cowhands to a ranch, because food kept them going on the range. If an outfit didn't serve decent food, the men would move on to a ranch that had a good reputation for meals. One story has it that one of the first questions a prospective cowboy would ask of the hiring ranch was "Who's your cook?" If the name was unfamiliar or the reputation of the cook bad, the cowboy would turn down employment and head for the next ranch.

Activities

Cowboy Cooking: Following are recipes for several of the more common meals or food items that cowboys would eat while on the range. This activity can be done in the classroom as well as on the ranch site. There is an authentic reproduction chuckwagon set near a clump of cottonwood trees, complete with a fire ring. You are invited to use this area for your class presentation while serving beans, biscuits or whatever the class has chosen for its menu. Please note on the reservation form if you will be conducting this activity and would like to use the chuckwagon area.

Bean Hole Beans: The Great Northern beans work well (what Grant-Kohrs Ranch uses for its demonstrations on-site).

1 lb. beans
1/2 cup molasses
salt pork or whole bacon
salt, pepper to taste

Dutch oven, large crock pot

Sort beans, picking out any dirt, rocks, etc. Place in a large pot (crock pot works well because you can cook in it too) and cover with water overnight.

Bring beans to a boil until the skins burst when spooned and blown (3 hours in crock on high). Pour off the liquid and save. Drop a chunk of salt pork (bacon) in the beans; add salt, molasses and fresh ground pepper to the liquid, then pour over beans to cover. Add another chunk of bacon, cover pot and simmer.

The hole in the ground method was commonly used on the range. First, the cook would dig a hole and start a hot fire until it had burned to coals. The pit would be larger than the dutch oven. The cook removed some coals, put the oven on the coals in the hole, put the other coals on top of the oven, then covered the oven and coals with 4 inches or so of dirt. The beans would cook 4 - 8 hours and be ready when the men came in to camp for the evening.

Sourdough biscuits:

2 cups starter*
1/2 cup flour
1 tsp baking soda
1 tsp salt
1 tb melted butter
fat or oil

Mix all ingredients. Add more flour if thin, making a stiff dough. Lightly knead to form biscuits and drop onto buttered oven. Allow to rise until doubled in size. Brush with melted butter. Bake at about 400 F. in a Dutch oven for a few minutes; reduce heat and cook until done - about 45 minutes.

*If you don't have starter, there are bakeries and specialty stores where it can be purchased. Otherwise, you can really skip most of the work and buy ready-made, brown and serve sourdough rolls just to give students a taste. But the work is half the fun!

Spotted Pup: (raisins and rice, rice pudding)

White rice (instant ok for this activity)
seedless raisins
sugar
cinnamon

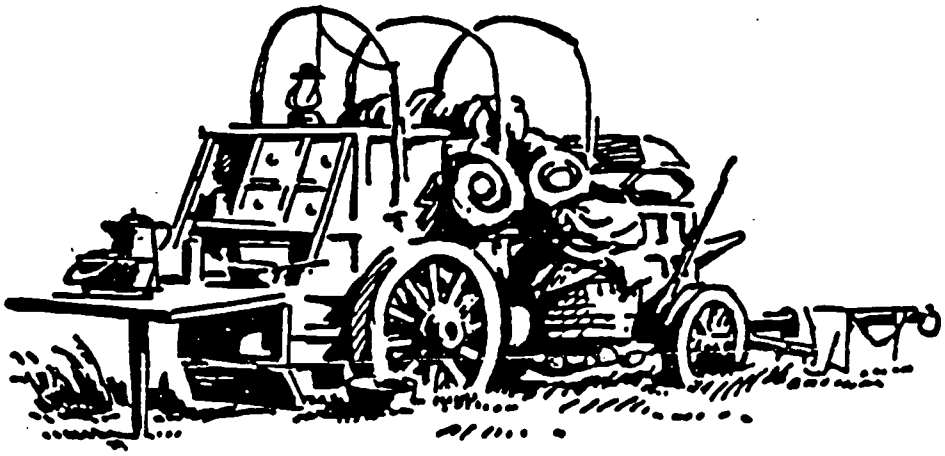
Prepare rice for number of students according to directions. Add a handful of raisins, enough for each student, after rice is done cooking. Add sugar to taste, and canned milk to make creamier if desired. Add cinnamon and stir in to taste. Serve warm. This can be cooked in a crock pot also, but a dutch oven is more authentic.

Other items still found today that provided variety in a cowboys' diet include: Carnation® canned milk, canned peaches and tomatoes, fruit pies (a real accomplishment in a dutch oven!), syrup, jerky and huckleberry juice. These are readily purchased in any store, and would provide topics for discussion about food traditions that have lasted for over a century.

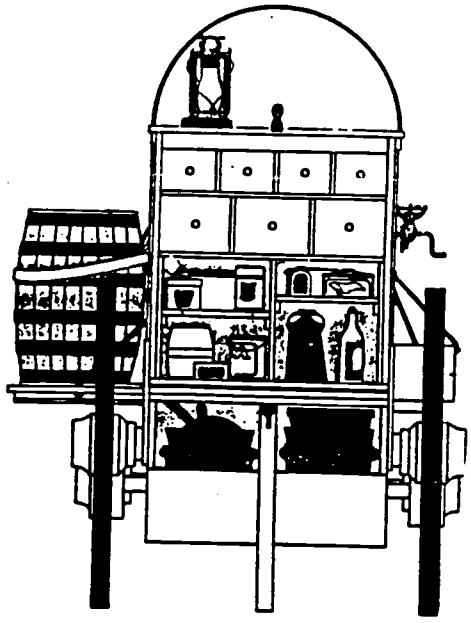
NOTE: If you are doing this activity on the ranch, your group will be responsible for providing all serving utensils and food items, and for clean up of the area. We suggest using small paper cups and plastic spoons for serving. We can provide burlap bags for sitting on, as well as for conducting any historic kid's games.

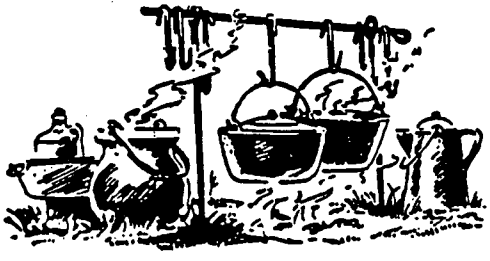
To complement chuckwagon cooking, we suggest reading an excerpt from the cowboy's journal in the teacher guidebook (Trail Drive), or have the students discuss or make up their own tall tales. This was a major form of entertainment on the range, as well as singing and playing a harmonica. Invite any student to bring along poems, songs and stories to tell as they sample their chuckwagon cooking.

For further recipes and information on the history of chuckwagon cooking, please refer to the **Resources** at the end of this section.









"Bacon on the pan,
Coffee in the pot;
Get up an' get it -
Get it while it's hot."



THE COWBOY OF MYTH

THE COWBOY

The most storied figure of the Old West was the Cowboy. He is shown here as Russell knew him best. He wears chaps, carries a Colt frontier model revolver and has his lariat loop out preparatory to choosing himself a mount

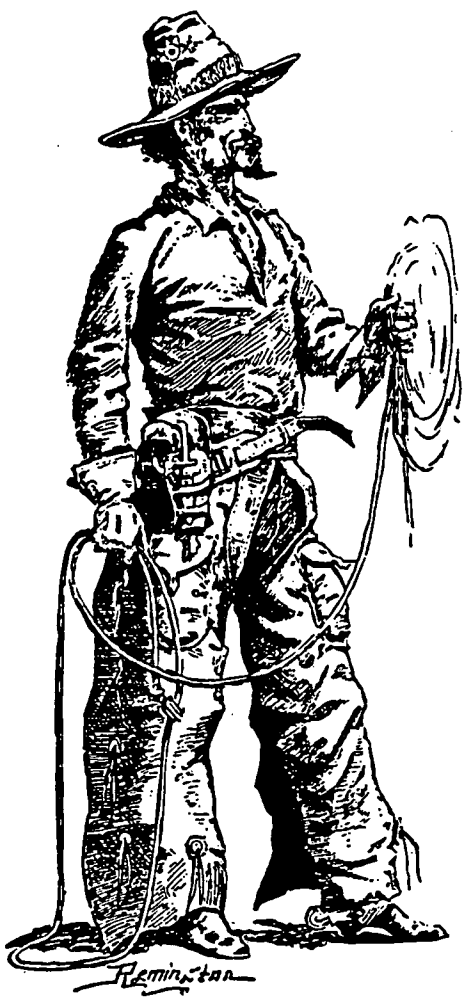
The vignette pictures the Cowboy about to rope an N bar N longhorn steer.

BEST COPY AVAILABLE

The Myth of the Cowboy

Their eyes were red and bloodshot from the dust and squinting at the blazing sun. Their clothes were oftentimes torn and travel worn, almost in shreds, and they did not resemble the silk-shirted rodeo performers of today....Many of the riders chewed tobacco,which really increased their desire for water, but the juice coated over their lips and protected them from the wind, dust and sun.
Neil R. Johnson, *The Chickasaw Rancher*

The above physical description hardly paints a picture of a hero. The cowboy's reputation was not always the best, either, due to "published reports concerning his tacky appearance, his violent behavior, and his disregard for the peace and quiet of Sunday mornings, church socials, and family picnics." (William W. Savage, *The Cowboy Hero*) Yet before the end of the 1880's, the cowboy had become both a romantic figure and a mythic hero, at least to many who had never met a real cowpuncher.



An Arizona Type by Frederic Remington, Century Magazine, April 1888

The transformation was due in part to a deliberate marketing effort. Europeans and Americans from the eastern United States were fascinated by the American west. The vast grandeur of the landscape, the proud and exotic (to them) existence of the Plains Indians, the danger and adventure of pioneer life: all of these stirred the imagination. These elements also sold newspapers, magazines, books, even paintings. Writers, journalists and artists flocked to the west to record what they found there, and in some cases, to improve upon the reality.

In 1883, *Buffalo Bill's Wild West* opened its first performance. Buffalo Bill himself (William F. Cody) had been a Pony Express rider, an Army scout and a buffalo hunter. The *Wild West* featured parades, demonstrations of trick roping, riding and shooting, and "spectacles." These last were "authentic" reenactments of scenes from western life and history, such as Indian war dances, Pony Express rides, Indian attacks, buffalo hunts and battles between the U.S. Cavalry and the Indians. Since Cody hired real Indians, the reenactments sometimes featured people who had actually been present at the original event. Other renowned Westerners, such as Wild Bill Hickok and Buffalo Bill, played themselves, blurring the line between reality and make-believe for their audiences.

Cody himself did not refer to these extravaganzas as shows, preferring to think of them as educational

events. Their popularity was such, however, that many other "wild west shows" sprang up, and these toured both the United States and Europe. The Miller Brother's 101 Ranch Wild West Show, based near Ponca City, Oklahoma and Pawnee Bill's show were two of the better known.

Some of the entertainers in these performances had actual experience as cowboys; others had none. "Buck" Taylor (Cody's "King of the Cowboys") did work on a ranch prior to joining Buffalo Bill's troupe. Bill Pickett, an Afro-American, worked as a cowboy but became famous as a champion bull-dogger with the 101 Ranch Show. Lucille Mulhall ("the first cowgirl") worked as a cowhand on her father's Oklahoma ranch, and went on to star in his Wild West Show. (Will Rogers, another cowboy with actual working experience, was also in that show.) Annie Oakley, the famous sharpshooter of Buffalo Bill's Wild West, was actually from Ohio. Needless to say, the dress of these performers was considerably more elaborate than the torn and dirty clothing of the working cowman.

Meanwhile, dime novels, magazine stories and plays featured brave cowboys performing unlikely physical feats to overcome villains and rescue women. These sold in the millions, and set the tone for the movie Westerns to follow. Radio and television shows continued the image of the cowboy-as-hero. Show business cowboys, however, seemed to have very little to do with cows and a great deal to do with bad guys. And they sang to the girl (or a horse) instead of to the cattle.

Today, the popularity of western movies and television dramas may have waned, yet the cowboy image still sells. Advertising campaigns using western themes abound, and designer western wear is marketed to urban cowboys and cowgirls.

What is it about the historic cowboy that made him so easily transformed into a figure of myth? Wendy Doniger O'Flaherty defines a myth as "a story where people find their most important meanings" (*Other People's Myths).* She elaborates by saying, "Myth supplies an ideal that ...may be impossible to live out literally...It is a target that we can never reach, ...but that establishes the full range of the scale in which we live." What values do we find embodied in the cowboy's story?

The old-time cowboys themselves, and those who observed them, spoke of an unwritten code of behavior. David Dary (in *Cowboy Culture*) lists some of the rules:

A cowboy was expected to be cheerful even if he was tired or sick
A cowboy was expected to have courage
No real cowboy was a complainer
A cowboy always helped a friend, and gave assistance to a stranger
or even an enemy in distress
A cowboy did the best he could at all times
A cowboy held women in high esteem

Others have written of the cowboy's intense loyalty to his outfit and its members, of his independent spirit, of his skill, of his common sense, of his generosity, of his pride, of his determination to "get the job done," whatever the obstacles. These perhaps suggest some of the values that our society sees as an ideal, a target "that establishes the full scale of where we live."

Discussion

Fill students in on the background material about the cowboy's transformation from itinerant laborer to romantic and mythic hero. List the cowboy "rules" on the board.

1. Do students think these offer a good code of behavior for today?
2. Are these the values that students are being taught in school? at home? in church?
3. The early cowboys were men, and these rules seem to be written only for men. Should women follow the same rules? Or is there a different code of behavior that girls learn? Should the rules of behavior be the same for both boys and girls, men and women? Why?

Activities

Cowboys in Advertising: Have students watch for examples of cowboys and western themes in magazines, newspapers and on T.V. Make a list and post examples on the bulletin boards. From what students have learned about cowboys, do they think these images reflect reality? Make a list of sports teams whose names have a western or cowboy influence.

Cowboys on Film: Early film makers successfully adapted stories with a western theme from pulp fiction and from illustrated magazines, where they found their images of mythic cowboy heroes. The "talkies" brought the advent of the singing cowboy, such as Roy Rogers or Gene Autry. Television moved Hopalong Cassidy and the Cisco Kid into American living rooms, and the brave and inventive cowboy (with his funny sidekick) became part of every child's consciousness.

The following guidelines offer suggestions for discussion with students about two Western films, both available on video: *Ropin' Fool*, starring Will Rogers and *Red River*, starring John Wayne.

Ropin' Fool directed by Clarence G. Badger (20 minutes)

This 1925 silent short is a showcase for the roping skills of Will Rogers. Rogers, who produced the film himself, was born in 1879 to a prominent family of the Cherokee Nation in Indian Territory. He grew up on the family ranch near what is now Oolagah, Oklahoma, and worked on a ranch in Texas as a young man. His passion for roping and riding won him starring roles in the Wild West shows and later in the Zeigfield Follies. It was his witty commentary, however, used on stage during his act, that eventually gained him world-wide fame. His easy-going humor and incisiveness, particularly when he discussed politics and current events, earned the love and respect of millions. His weekly newspaper columns, magazine articles, radio show and movie roles made his name a household word. When he died in a plane crash in 1935 (with fellow Oklahoman Wiley Post), banner headlines in newspapers around the world read WILL DEAD IN CRASH. There was no question that people would know who "Will" was. For many, Will Rogers represented the common sense, the humor, the lack of pretense and the easy-going approach to life that personified the Westerner. Historian Howard Lamar says, "Will Rogers not only gave the cowboy a voice, but seemed to demonstrate that out of travel and experience could come wisdom and indeed a philosophy of life" (*Buffalo Bill and the Wild West).*

Before viewing the film: Have students pay particular attention to the opening scenes, which demonstrate not only the skill needed by a cowboy to rope a steer, but also show the training required of his horse. Notice how the horse must plant its feet firmly and pull the rope taut after it is wrapped around the saddle horn.

After viewing the film:

1. Using the video machine, watch a slow-motion sequence at fast-forward speed. What techniques are seen in slow-motion that are not visible in more normal speed? Compare to the "instant replay" technique of today's T.V. sports coverage.
2. Watch part of the tape with the volume turned off. What is the effect? Try alternative music with the tape and explore the effect of the music on the visuals.
3. Discuss the miniature "tall tales" used in the film (e.g. "My brother could throw a rope up in the air and climb up it"). What other examples of humorous exaggeration are used? Assign someone to report on the tall tales featuring cowboy "Pecos Bill." Some might compose their own tall tales with a cowboy theme.
4. What do women do in the film? Retell the story from the point of view of one of the females. Rewrite the story with Annie Oakley (a famous sharp-shooter and trick rider with Buffalo Bill's Wild West show) as the main character.
5. Is "Ropes" Riley a likeable hero? Why or why not? Does he show any of the characteris tics written of in the "cowboy code" (see p. 61)?
6. Research the life of Will Rogers. Listen to some of his radio broadcasts (available on cassette) and report on his style of humor.

Ropin' Fool is available for sale on video from the Will Rogers Memorial, P.O. Box 157, Claremore, Oklahoma 74018; 918-341-0719.

Red River directed by Howard Hawks (125 minutes)

This 1948 film tells a fictional story of the first cattle drive up the Chisholm Trail. The story begins in 1851, then skips to 14 years later after the Civil War. Texas rancher Tom Dunson (played by John Wayne) is broke. He hopes to save his ranch by driving a huge herd to market in Sedalia, Missouri (probably moving up the Eastern Trail to the Shawnee, and then on to the Sedalia Trail—see map p. 36). Dunson's determination to complete the drive despite all obstacles turns to monomania, and he pushes his cowboys beyond endurance. Dunson refuses to believe rumors that the railroad has reached Abilene, Kansas, and won't turn the herd toward the Chisholm Trail, which would mean a considerably shorter journey. The cowboys, led by Dunson's adopted son, Matt (played by Montgomery Clift) revolt, take over the herd, and head up the Chisholm Trail. Dunson pursues them, having promised to kill Matt. The climax of the film takes place when the two face each other in Abilene.

Before viewing the film : While watching the film, students should be alert to the accuracy of the portrayal of cowboy life. Given what they've learned, do these seem like "real" cowboys or Hollywood cowboys? Suggest also that they watch for the differences in the ways Tom Dunson and his adopted son, Matthew Garth, handle problems.

After viewing the film:

1. What details in the film seemed accurate? Which do not?
2. Indians in the film are either faceless villains (the Comanches) or comic figures (Quo). Discuss the limitations of this viewpoint, which ignores the

fact that the Indians were defending their homes and families from invaders.

3. What were Dunson's good and bad characteristics? Matt's? Did either or both of them follow the "cowboy rules?" (See p. 61) Is it possible to have so much of a good quality that it becomes bad?
4. What were the good and bad characteristics of the two women in the film (Fen and Tess)?
5. How does Dunson's behavior early in the film (such as his murder of the Mexican trying to protect his boss's land) prepare you for the later conflict with Matt?
6. Who was your favorite character? Why? Your favorite scene? Why?

Red River is available for sale or rental from Blockbuster Video.

The Cowboy in Art: Remington and Russell

Frederic Remington and Charles Russell are perhaps the two best known of the artists who recorded the "wild west" with its Native Americans, its trappers and hunters and its cowboys. Both worked to give accurate portrayals of the reality they saw, and yet at the same time they managed to contribute to the myth of the west that was fast disappearing.

Remington was a native of New York state, a student at Yale's School of Fine Arts, when he went west in 1881 to seek his fortune. He was enthralled by what he found there, and began drawing and painting a record of what he experienced. Later he wrote, "...I knew the wild riders and the vacant land were about to vanish forever...I began to try to record some facts around me...I saw the living, breathing end of three American centuries of smoke and dust and sweat."

His illustrations were published consistently in Eastern magazines and newspapers, and he gained credibility by his determination to get the visual details correct. Clothing and weapons were authentically portrayed. One of his greatest talents was his ability to depict with accuracy humans and horses in motion. He wanted his own epitaph to be: "He knew the horse."

Yet Remington was not interested in photographic exactitude. As he himself stated it in a letter to a friend, "I can beat a Kodac [Kodak camera]—that is, get more action and better action because Kodacs have no brains--no discrimination...the artist must know more than the Kodac..." Much of Remington's work crackles with energy, with the possibility of blood and sudden death. In creating so many scenes of high drama, Remington made his own contribution to the idea of the cowboy as mythic hero. Indeed, this was the way Remington himself regarded the cow-puncher, as he shows us in a canvas called "The Last Cavalier," which features a cowboy on horseback riding alongside a ghostly collection of knights and warriors of old.

Charles Russell was born in St. Louis, Missouri, and fulfilled a long-time dream in 1880 by taking a trip to Montana at the age of 16. He fell in love with the area and elected to stay, working on a sheep ranch, as an animal skinner, and eventually, as a cowboy. As he put it, " ... for 11 years I sung to the horses and the cattle." Even Russell himself admitted that his roping and riding skills were never the best, but he was captivated by the life and used his natural talent for drawing and sculpting to capture the humor and the drama he found there, to the pleasure and entertainment of the people he depicted.

It has been said of Russell that he was a storyteller first and a painter second (Goetzman and Goetzman, *The West of the Imagination*). The strong narrative quality of his paintings, and his ability to create memorable individuals on canvas characterized his work. His first-hand knowledge of animal anatomy (from his days as a skinner) enabled him to depict, with life-like accuracy, the array of wildlife that inhabited his adopted state. According to friends, he often kept a piece of soft wax in his pocket, where he worked it with one hand while telling a story. At the end of the tale, he would pull out a perfectly modeled animal to illustrate his yarn.

Another characteristic of Russell's art was a deep respect for the Native Americans of the area, such as the Sioux, the Cheyenne, the Crow and the Blackfeet, with whom he lived for a time.

According to Russell, "The Red Man was the true American. The history of how they fought for their country is written in blood, a stain that time cannot grind out. Their God was the sun...their church all out doors. Their only book was nature and they knew all of its pages...." He began including a bleached buffalo skull in all his paintings, a symbol of the lost Paradise of the Plains Indian. Later, he adopted the skull as his personal mark, using it as a signature on his work, along with his name.

Russell's work first gained popularity in Montana, where he often gave it away or traded it for necessities. Eventually, however, his work was to be found in New York galleries, along with Remington's. These two were instrumental in preserving both the history and the myth of the American West.

That committment to history and tradition continues among contemporary western artists. Often their work captures a single dramatic moment, apparently lifted from an on-going story which the viewer is invited to finish in imagination. Frequently the style is realistic and the detail authentic; sometimes the subject matter is from an earlier time and place—the Old West of history and myth.

Western art commonly is criticised for its lack of innovation, yet: "To the tradition-oriented Western artists, the message is not how innovative the individual artist may be, but how memorable, how worthy of preservation and remembrance, is the image he creates." (Goetzmann and Goetzmann, *The West of the Imagination)*

Activities

Looking at Art

Aesthetic scanning, a technique developed by H. S. Broudy, is a way of looking at art that offers practical classroom applications, even for a teacher who may not have a great deal of background or much information about a particular work. This approach teaches a way of looking at art and a vocabulary that enables both students and teachers to move beyond the "I like it/ I don't like it" school of art criticism.

Using aesthetic scanning, viewers study a work of art (in the classroom it may be a reproduction) by analyzing its characteristics:

1. Sensory properties such as line, shape, color, and texture
2. Formal properties such as balance, repetition, rhythm, contrast, variety
3. Expressive properties are visual characteristices used to evoke a feeling such as sadness, tranquillity, tension, joy, etc.
4. Technical properties such as the characteristics of the materials used and the ways in which the artist used them.

The teacher acts as the discussion leader in this approach. The ground rules are that the aesthetic property must appear in the work and the viewer must be able to identify it by describing it or pointing to it. Typical questions asked of the group might be: What color is used most? How many shades or tints of one color can you find? How many colors are used? Do the colors tell anything about time of day or season? Are any colors repeated? Do you see repeated lines?

Do you see anything that would feel sharp, prickly, soft, slick, etc. Are most of the shapes round, square, open, closed, etc.? What takes up most of the space in the picture? Is one side of the picture heavier than the other? What is the main idea of the picture? What is its most important part?

Additional information about the artist, the medium used, or the historical period in which the work was produced can be used to help students understand more fully why the artist made certain choices. Even without this background, however, careful questioning about what actually can be seen in the painting (or other art object) will lead to informed discussion. This same approach is useful as well in examining artwork produced by the children themselves.

For more detailed information on this approach, see:

Scanning Works of Art: a Guide for Teachers, by Nancy B. Roucher, available from Project HEART, 2240 E. Geddes, Decatur, IL 62526

"Finding Buried Teasures: Aesthetic Scanning with Children" by Gloria J. Hewett and Jean C. Rush, *Art Education,* Vol. 40, No. 1,January 1987, pp.41-43

Marks and Signatures: After students have an opportunity to see Russell's trademark buffalo skull, either on paintings at the museum or on reproductions of his work, give them the opportunity to design signature marks of their own.

Paper Talk: Throughout his life, Charles Russell wrote notes and letters to friends which he illustrated with drawings and watercolors. These are now treasured in museums and private collections. Have students write and illustrate a letter to a friend, either describing an incident in their own lives or describing something they found interesting in their study of the cowboy.

Exploring Western Art (adapted from materials written by Marianna Adams for the Lowe Art Museum at the University of Miami)

Materials needed: Postcards or other reproductions ~~(see source list on p. 85)~~, statement cards, descriptive labels, a dictionary.

This activity will enable students to focus on some of the sensory properties of a work of art (color, line, shape, texture, etc.) as well as its expressive or emotional qualities. It also will challenge and increase vocabulary.

1. Prepare 3 envelopes, each with a statement card and with a set of labels that can be used to complete the statement. (See examples to follow.) Be sure to include some blank labels so that students can add their own adjectives. (For convenience, use a different color paper for each set of labels.)
2. Students will work individually or in pairs for this activity.
3. The student chooses a reproduction to explore, and removes the statement card and the labels from the first envelope (dealing with color).
4. He/she places the statement card ("The colors in this work of art can be described as...")

below the reproduction, and begins reading through the labels, one at a time. If a word accurately describes the reproduction, it is placed face up below the statement card. If it does not fit, it is returned to the envelope.

5. Unfamiliar words or terms should be looked up in the dictionary. Students may add their own descriptives, using the blank labels.
6. The process is repeated, using the envelopes on line and shape and on moods or feelings.
7. When all the labels have been completed, the student should study the reproduction and the descriptive terms, then write a paragraph or poem about the work of art, using some of the words on the labels.
8. Statement cards and labels are returned to the correct envelopes.

Envelope 1
Statement card: The colors in this work of art can be described as...
Possible labels:

vibrant	harsh
muted	glowing
bright	repetitive
luminous	flat
somber	dark
subtle	light
soft	dull
warm	cool

Envelope 2
Statement card: The lines in this work can be described as...
Possible labels:

floating	bold
curved	wavy
heavy	straight
jagged	swirling
fluid	thin
horizontal	diagonal
long	short
continuous	broken

Envelope 3
Statement card: For me, this work of art suggests these moods or feelings...
Possible labels:

surprise	tension	anger
aggression	explosiveness	reverence
fear	awkwardness	grace
peace	joy	calm
tenderness	harmony	anxiety
meditation	humor	elegance
mystery	impulsivity	quiet
playfulness	stress	dreaminess
turbulence	frenzy	worshipfulness

The Art of the Title: In this activity, students will focus on the meaning and content of a work of art and attempt to match titles with the appropriate works.

Materials needed: a set of postcards or other art reproductions; labels with the corresponding titles of the works.

1. Divide the class into teams of two, and give each team a selection of reproductions and title labels. Explain to students that they will try to match each work of art with the title chosen by the artist without looking at the back of the card, where the title is listed.
2. After teams have agreed on their answers, they can check themselves by looking at the backs of their postcards. Have them make any necessary corrections.
3. Discuss: Many titles are straight-forward descriptions of what is represented in the work. Some, however, add more information or contribute to the mood of the painting. Ask students to contribute examples from their selections.
4. Discuss the possible meanings behind these titles. (For example, a Remington painting titled *The Fall of the Cowboy* pictures two cowboys stopped at a gate. One has gotten off his horse to open the gate so they can pass through. Remington seems to refer to the fencing of the open range as the end of the "glory days" of cowboying.)
5. Did learning any of the titles change how students related to a particular work?
6. Suggest that students produce a drawing or painting of a scene based on their own "experiences" in the Trail Drive Game. They should give particular attention to the titles they invent for their works.

Storytelling in Art: Western art comes from a strong narrative tradition. Using postcards (see below for possible sources) or other reproductions, have students "flesh out" the story.

1. Give each student a postcard (or other print) from which to work.
2. Students are to look carefully at the image and decide what is happening. They will write the story behind the painting.
3. Two or three sentences should tell what happened before the incident pictured; two or three sentences should describe what is happening in the picture; two or three sentences should explain what happens after the pictured moment has passed.

Personal Taste: After students have had an opportunity to familiarize themselves with your collection of reproductions, have them choose their individual favorites. They can write or discuss what they like about their choices. Make a bar graph to indicate which paintings were chosen most frequently. Did class members most often choose the more dramatic scenes? the most colorful? Was a particular artist more popular? Are there other patterns in the profile of the group's favorites?

Remington's *The Cow Puncher*: Ask students to look at the ~~cover of this teachers' guide~~ next page. Reproduced there is a copy of a painting made by Frederic Remington in 1901. He used black and white oil paint on canvas. The original painting is 28 7/8 inches by 19 inches in size. Writer Owen Wister wrote this poem to accompany Remington's painting:

He rides the earth with hoofs of might,
His is the song the eagle sings;
Strong as the eagle's, his delight,
For like his rope, his heart hath wings.

Use the following questions to investigate the reproduction with students:

1. Describe what you see in the painting.
2. Considering what you have learned about cowboys, would you say this is a realistic depiction of one? Why or why not? Is Wister's poem realistic? Why or why not?
3. Remington "places" the viewer right in the path of the charging horse. How does that affect the mood of the painting?
4. What does the use of black and white do for the "feel" of the painting? Would you like it better with color?
5. The artist left out all background details, even earth and sky, yet he chose to include the shadow of the horse and rider. Why? (Hint: cover the shadow with your hand and see how it changes the painting.)
6. Although Remington prided himself on the authentic details he used in his paintings, this one has several which are not accurate: the cowboy's hat is falling into his eyes; his hand is in the wrong position for throwing his rope; the loop of the rope is dragging; he is wearing his quirt on his right wrist where it will tangle in the rope. Do you think Remington was careless about these details, or did he choose to paint them this way? What reasons do you think he has? Do these inaccuracies spoil the painting? Do they make it less "realistic"?



THE COW PUNCHER



THE COWBOY

The most storied figure of the Old West was the Cowboy. He is shown here as Russell knew him best. He wears chaps, carries a Colt frontier model revolver and has his lariat loop out preparatory to choosing himself a mount.

The vignette pictures the Cowboy about to rope an N bar N longhorn steer.

RESOURCES - The following publications are listed here as sources for further reading and investigation into Cowboy Culture Activities presented here. Those marked with an asterisk are suitable for students.

Abbott, E.C. and Huntington, Helen. We Pointed Them North. New York: Farran & Rinehart, 1939. Second Print 1954. *

Adams, Andy. The Log Of A Cowboy. University of Nebraska Press 1964 (reproduced from the 1903 edition. *

Adams, Ramon F. The Old-Time Cowhand. Macmillan Co., 1961. *

Adams, Ramon F. The Best of the American Cowboy. University of Oklahoma Press, 1957. *

Adams, Ramon F. Come An' Get It: The Story of the Cowboy Cook University of Oklahoma Press, 1952 *

Barrows, John R. U-Bet: A Greenhorn in Montana University of Nebraska Press, 1934. *

Brown, Dee & Martin Schmitt. Trail Driving Days. Charles Scribner Sons, 1974. *

Carley, William T. Cowboy Lore. Naylor Co., 1933. *

Choate, Julian E., Jr. and Joe B. Frantz. The American Cowboy. University of Oklahoma Press. 1955. *

Dale, Edward Everett. Cow Country. University of Oklahoma Press, 1965.
" The Range Cattle Industry. University of Oklahoma Press 1960.

Gard, Wayne. The Chisholm Trail. University of Oklahoma Press 1954. *

George, Susanne K. The Adventures of the Woman Homesteader. University of Nebraska Press, 1992. *

Goetzman, William H. and William N. Goetzman. The West of the Imagination. Norton & Co., 1986. *

Haley, J. Evetts. Charles Goodnight, Cowman and Plainsman. Houghton Mifflin, Co., 1936. *

Hassick, Royal B. Cowboys. Mandarin Press Ltd., 1974. *

Hough, Emerson. The Story of the Cowboy. New York: D. Appleton, 1910. *

Howard, Joseph K. Montana, High, Wide and Handsome. New Haven: Yale University Press, 1943.

ed. Kelly, Leo. "Up The Trail in '76: The Journal of Lewis Warren Neatherlin" Chronicles of Oklahoma, 66 (Spring, 1988) pp. 22-51

Logan, Mike. Bronc to Breakfast, a book of cowboy poems. Buglin' Bull Press, 1988. *

Mather, Christine. True West. Clarkson Potter Press, 1992. *

Osgood, Ernest Staples. The Day Of The Cattlemen. University of Minnesota Press, 1929. *

Rickey, Don. $10 Horse, $40 Dollar Saddle. Old Army Press 1976 *

Roach, Joyce Gibson. The Cowgirls. University of North Texas Press, 1990. *

Rollins, Philip A. The Cowboy. Charles Scribner's Sons, 1992. *

Savage, William Jr., Cowboy Life. University of Oklahoma Press 1975. *

Sunset Magazine, source for Sourdough Starter for Chuckwagon Cooking send SASE, business size, and $1 to:
Starter, Sunset Magazine 80 Willow Road
Menlo Park, CA 94025

Time-Life Books, editors. The Old West series - The Cowboys. Time, Inc. 1973. *

Toole, K. Ross. Montana: An Uncommon Land. University of Oklahoma Press, 1959. *

Ward, Fay E. The Cowboy At Work: All About His Job and How He Does It. University of Oklahoma Press, 1987. *

Warren, Conrad K. Conrad Kohrs: An Autobiography. Platen Press, 1977. *

COTTONWOOD CREEK
BACKGROUND



BACKGROUND INFORMATION

Cottonwood Creek Nature Trail

Theme: A variety of life can be found in this special place, called a **riparian zone.** Here, the plants, animals and water give us clues as to the general health of the environment.

This section concentrates on environmental awareness, using Cottonwood Creek and the nature trail as an outdoor classroom. Each of the following activities are self-contained: pre-visit prep, on-site experiments and ideas for extended projects. The selections in this guide are open to modification by the teacher to better accommodate grade and skill levels. Use these activities all or in part. Refer to the Resources at the end of this section for additional information on environmental and natural history lessons.

Objectives: After visiting the nature trail and performing lesson(s) in this guide, students will be able to:

- Describe a **riparian** zone
- Name two types of trees that live near water
- Tell how people use the creek
- Name 2 birds, fish, mammals or insects living in or near the creek
- Describe 3 things plants need to live
- Describe a 'discovery' process used in one of the lessons
- Name at least 3 parts of a habitat

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Cottonwood Creek: An Overview

You are about to take a short (1/2 mile one way) walk through a unique area within Grant-Kohrs Ranch National Historic Site. The trail you will follow is called Cottonwood Creek Nature Trail, and is a recent addition to the site. The purpose of the trail is to provide an outdoor setting for school groups to learn more about the working components of nature within a human-altered environment.

The trail takes you through what is termed a riparian zone; think of it as the green place that surrounds a creek. A riparian zone relies on water to keep it green, and to keep the plants and animals in it alive. A riparian zone is also very sensitive to changes in the environment such as pollution, soil disturbance, fire, farming and grazing. The health of a riparian zone is an indicator of the general well-being of the surrounding environment.

But how do we determine if an area is healthy? Scientists have tests they can do on the water, soil, plants and animals; similar to what a doctor does to people to see why they're sick. Making people well again is sometimes easier than making nature healthy.

Within the Cottonwood Creek Nature Trail setting live many plants and animals. You will have the chance to explore and discover more about where and how they live as you choose an activity from the following pages, or make one up to suit the class skill level and interest. The imagination and enthusiasm of the teacher and the students are the only limits.

The rules of the trail are simple, and make for a more enjoyable visit:

-- *Please remain on the designated path, except where noted for group activities.*

-- *There are litter barrels at the beginning and end of the trail - please try to deposit all trash in them.*

-- *No food or picnicking is allowed on the trail.*

-- *Restrooms and water are at the main parking lot.*

-- *Do not throw rocks, branches or anything at each other or in the water, pastures, etc. Cattle and horses will spook, plus wild animals live in the area and would not appreciate having things tossed at them!*

-- *All items collected on the site for the educational activities must be returned where you found them before you leave. Only collect objects which are loose on the ground; do not pick plants, flowers, leaves etc. from living trees or bushes.*

Your cooperation is appreciated by the ranch staff and other visitors.

The activities in this guidebook were chosen because they offer introduction to nature, classroom, site visit and extension activities. Each of the lessons can be adapted to most grade levels other than for which they were written. The Resources at the end of this section provide additional information and activity suggestions, most of which are curriculum-based and available at low or no cost.

BEST COPY AVAILABLE


COTTONWOOD CREEK
NATURE TRAIL

Nature Hunt

An Environmental Investigation

BY
NATIONAL WILDLIFE FEDERATION
MINNESOTA ENVIRONMENTAL SCIENCES FOUNDATION, INC.

Nature Hunt gets young children involved in outdoor activities. It also gives experience in several disciplines which relate to primary school curriculum. The children will experience the workings of nature during the course of the unit, and this, hopefully, will form a basis for continued enthusiasm about the environment.

The success of **Nature Hunt** depends upon small groups interacting, exchanging ideas, observations and findings. The unit can be instructive for both you and your students. It can also be fun.

INTRODUCTION

Nature Hunt is set up as a game. On a trip to a local natural area or park, small groups of children are given Nature Hunt containers which hold a collection of natural items found in the park: soil samples, rocks, and so forth. The children are also given some photographs of areas in the park.

The point of the game is to locate items as similar to those in the container as possible, and to determine where the photographs were taken. The children will collect these matching items and other items they find interesting. In addition, they will collect evidence that humans use the park. All of this will lead to sharing reactions and communicating through language, art, and music.

We have suggested some ways to put together the Nature Hunt containers, including information on what items each might contain. These suggestions are flexible and lend themselves to variation. The unit can be used in cities and deserts alike. Experience with your own class will probably give you ideas for variations that work best with your own students.

The pre-trip activities take several days. The major outdoor activities take most of a day and can be planned as a filed trip to a local natural area or park. The post-trip activities can extend beyond a week if desired.

The activities in this unit are intended to help youngsters in these learning areas:

1. **Observing**--opening eyes, seeing details.

2. **Comparing**--noting similarities and differences.

3. **Arranging**--putting natural items in some order.

4. **Re-arranging**--putting the same items in a different order.

5. **Becoming aware of the environment**--appreciating the role of their surroundings in relation to our lives.

6. **Noticing human use of nature**--seeing how people fit into their immediate surroundings as well as the larger world.

7. **Communicating**--sharing ideas through discussion, conversation, tape recordings, art work, experience charts, stories, poems, etc.

8. **Thinking creatively**--considering extended use of an area by special groups, such as grandparents, crippled children, etc.

MATERIALS

camera
film
small plastic bags
shoe boxes or
    3 lb coffee cans (5 or 6)
labels--heavy duty; or
    cardboard for making labels
tagboard for name tags--
    several colors
large paper bags
pencils
crayons
scissors
drawing paper
construction paper
plastic spray
stapler
3x5 cards

Nature Hunt

Preparation

Allow yourself a week prior to the trip to complete the preparations:

A. For the Field Trip

Materials

photographs	plastic spray
three pound coffee cans	3x5 cards
or shoe boxes	cardboard or labels
plastic bags	stapler

1. Select a natural area or park (Cottonwood Creek Nature Trail at Grant-Kohrs Ranch is perfect for this activity).

2. Take photos of the following (or if you cannot get to the site to take the photos, use maps, brochures, textbooks for general likenesses)

   a. Landmarks--5 or 6 different ones (gates, mountains, fences, pastures, buildings etc.)
   b. Views of any water areas, rivers, streams, ponds, swamp, about 10 photos.
   c. Trees that can be easily distinguished--10 or more
   d. Special features--soil erosion, fallen trees, fire area, etc. Try to include at least six features, or one for each group of children.

3. Have these photographs developed and printed. Have the clear pictures enlarged to 5x7 or a size easy to see by the children. Allow time for this part of the activity. When you are finished taking the pictures and have them enlarged, you may have more than 30 prints. For some things such as the trees, you may want different angles. The pictures should be divided among the containers.

4. Collect items at a park or natural area you have selected. Collect only items whose absence will not damage living things. If you collect items from Grant-Kohrs Ranch, please return them where you found them at the end of this activity. Make sure you have one of each item for every group. You will want four or five children in each group. Although not necessary, it will add variety tot he nature hunt activity if you select different types of each item for the Nature Kits. For example, under the category "dead leaves" you could try to get samples from a variety of trees. Then each kit would have a different kind of leaf.

   a. Collect **dead leaves (6)** of different varieties.

   b. Select **weeds (6)** of different sizes.

   c. Collect **rocks (6)** of different shapes, sizes and colors.

   d. Try to find **seeds and seed pods (6)**.

   e. Collect **fruits or nuts (6)** such as pine nuts, acorns, hickory, berries. (If none can be found, use photos instead).

f. **Pine cones** (6) may be available, too.

g. Try to locate five or six different colored **soils** or of different texture (sand, black, topsoil, clay, etc.).

h. **Rotting or charred wood** (6) should be abundant.

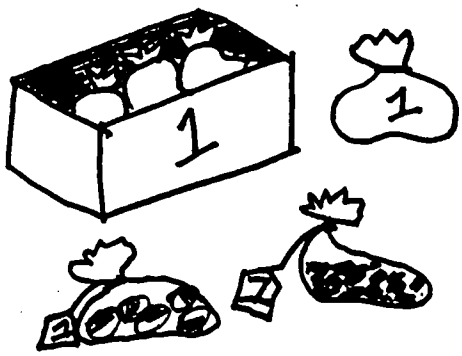
i. Collect **green leaves** (6) to contrast with the dead leaves.

j. Gather some **bark samples** from the ground only.

5. If you want to save the items for use next year, spray with the plastic adhesive.

6. Using the 3x5 cards, prepare sets of 'feely' cards. Each card should contain one word describing a 'feel', and all sets should contain the same group of words. Words you might use are: fuzzy, crispy, rough, smooth, bumpy, prickly, crispy, soft, hard, squeezy, fluffy. There should be as many sets of the cards as there are kits.

7. Prepare and label the containers. If you have six groups, you will need six containers and six sets of materials.



For your nature hunt containers, use either the three pound coffee cans or the shoe boxes. Mark each container carefully with a different number, writing the respective numbers on both the containers and covers. Each container should include the following:

A total of at least four photos, one each--landmark, manmade or natural
water area, one view
tree
a special feature

Label all photographs with the number of the container they are in. Wait until the day of the field trip to put the photos in the containers, so that moisture or the other items won't ruin them. Divide the other items, putting one of each of the gathered materials in a small plastic bag. Number all items using tags made from cardboard. All items for container #1 should be labeled with #1, and so on. Staples can be used to attach the tags to the plastic bags.

Place a set of the 'feely' cards in each box, with numbers on the backs of each card the same as the kit's. When on the nature hunt, the children will look for an item that feels like the word. There's a lot of room here for innovation. For example, instead of words describing a feel, you might want to use a color word.

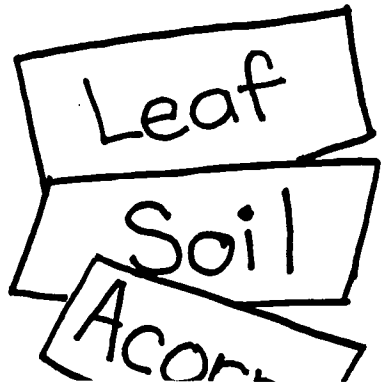
Later on, in the pre-trip arrangements, the children will make personal name tags. Each team should have a different number, corresponding to the number of that teams' nature kit. All members of each team should have that number on their name tags. This helps getting the members of the team together, and in keeping all the items in the kit in which they started. A color code could be used to identify teams and kits, instead of numbers.

B. For the Classroom

Materials

tag board





1. Prepare word cards naming, describing, or relating to the items you are actually including in the hunt. These cards are for use in the class and are distinct from the 'feely' cards. They will probably include some of the following:

leaf	leaves	plant	weed	rock	soil	bark
creek	river	sand	dead leaves		acorn	seed
cone	seed pod	wood	charred wood		fuzzy	soft
prickly	bumpy	rough	smooth	hard	squeezy	fluffy

2. Prepare any other word cards you feel would be appropriate to the group. Some suggestions:

nature hunt			like		similar	
park	walk	bus	trip	plastic bag		container
box	coffee can		arrange	humans	evidence	

C. Pre-trip Arrangements

MATERIALS --- note cards large brown paper bag
colored construction paper for name tags

1. Bus reservations
2. Permission slips
3. Parents for chaperones on the trip (1 per 10 students).
4. Prepare name tags for each group, using either a color or number; make sure it is the same for all students in the group, items in the box and the box.
5. Label several note cards with the group number and the chaperone name.
6. Label a large paper bag for each group. Use the group number and the chaperones' name. This is for collecting evidence of humans (trash, paper, cans, litter).

Classroom Activities

MATERIALS

blocks	rulers	grass	word-cards	leaves
containers		photographs	magazines	

Introduce the concept of "alike" and "similar".

Select man-made items that are exactly alike by most outward appearances--two blocks, two rulers, two coffee cans, etc. Point out their exact likenesses. Select two blades of grass, two leaves, two rocks, and two pieces of bark, and point out their similarities. It is very hard to locate two of anything that are exactly alike. Explain that they are the same type of item, color, texture, etc., and that makes them similar.

People can be very exacting in looking for similarities (leaves could be considered similar only if they are from the same tree), or they can be very loose in looking for similarities (any two leaves would be considered similar just because they are leaves). On the first day of this study, present the class a contrast between man-made items and natural items by using the distinction between the words "alike" and "similar". Have examples available. On the second day ask the children to bring in items or tell about items they found and discuss their "alikeness" or "similarity".

Introduce the containers.

1. Show the class one container.
2. Indicate the labeling by number or color, and explain its purpose.
3. Show them that in each container all numerals are the same.
4. Examine and display all the items.

5. Bring our the other containers and have groups of children examine them and the contents.

6. Exchange containers if there is time.

7. Have the class make comparisons between containers.

Have the children:

1. Discuss the items, numbers, and purpose for coding.

2. Arrange the items. Rearrange the items. You can even mix the contents of one container with another. The coding will help return the correct ones together.

3. Play with the contents.

4. Study the word cards and match them with the items.

Resort by placing all labeled items back in the proper container. Place several small empty plastic bags in each container. Place the photos into the containers on the day of the trip. Remove these when you return to school.

Field Trip

MATERIALS

Nature Hunt containers brown paper bags

Arrange for meeting times with bus driver, class and chaperones. Upon arrival at the park or natural area, allow for a short free exploration, keeping each group of children together with their coded group members and the chaperone.

Pass out a Nature Hunt container to each group.

Give each chaperone a paper bag, note cards and pencil.

A good way to conduct the Nature Hunt would be to have the chaperones give their group the items one at a time from the kit and them have the children go out in their groups looking for a matching item. It is best for the adults to keep members of the group in sight. When the children find a match, they should return to the adult, put the two matched items in the kit, and then receive the next item. It is not necessary to mark the items the children find, just put them in the box loosely. Use the same procedure when finding items for the 'feely' cards.

Few of the contributions the children make will be incorrect. Almost any item they find will match the sample in some way. Adults can ask them to clarify why they chose a certain item as a match.

When the children are looking for the landmarks, encourage them to ask within their group what it is they are looking for and where it might be found. Shortly before leaving the nature trail, use the paper bags to collect any evidence of humans in the area. They can note anything they find that is not natural to the area, and then discard of the litter in the proper containers.

Post-trip Activities

A. Putting Things in Order

1. Have the children remove the photographs from the containers.
2. Collect the notecards from the chaperones to compile any comments and for discussion in class.
3. Have the groups display their finds in a separate area, coding it with the number or color of the group.

4. Each team will have come back to class with a container full of materials they found. They may have forgotten some of the characteristics used to match certain items, but the purpose of the unit has been served by the activity itself.

5. Suggest that the children arrange each display with "alike" and "similar" materials together.

6. Display the "human evidence" separately (if it has made it back to the classroom; if not, describe or draw what was found).

B. Sharing Ideas and Reflections

1. Discussion--either as a whole class or in small groups.
2. Experience chart--this will be a large sheet of poster paper on which you record the experiences related by the students in class discussions.
3. Class-built story--a composite story told by the whole class or a member from each team, describing the field trip activities.

C. Recording Personal Responses

1. Drawing or painting of memories
2. Tape recording students' reflections
3. Tape record story or poems

D. Other Things To Do

1. Have students write a poem about the trip and what they saw
2. Have students sing a song using their poem
3. Have the class draw pictures of events of the trip

E. Re-Ordering Items

1. Have the class remove the items from the display and 're-order' them. Encourage them to find new sets of "alike" and "similar" items.
2. Have individuals or groups create displays using a word card and all items that can be associated with it.

F. Discussion Suggestions

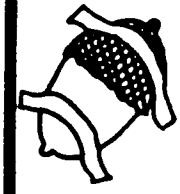
1. Personal responses to any part of the trip
2. Sharing insights
3. Sharing ideas about an arrangement of items
4. Review "alike" and "similar"
5. Examine evidence that humans use the natural area
   Ask things such as: What is it? What is it used for?
   Where was it found? What does this tell you about the people who left it?
6. Ask the students about the uses of the area
   How do (class level i.e. kindergartners) use the area?
   How do parents use the area? Grandparents?
   How could the area be made more fun for (different users)?

G. Activities for Older Children (3rd grade up)

Develop a chart of material and word cards. For the vertical and horizontal axes on this chart use the words written on the 'feely' cards. The chart should be large enough so that each object the children found on their walks will fit in a block. See the sample at the end of this section.

In the boxes the children can put objects that can be described by the corresponding words on both axes. For example, a leaf could be smooth on one side and prickly on the other. A coma from a milkweed could be both smooth and fluffy. It also could be fuzzy. There are many possibilities with this type of chart.

The students will probably have ideas of their own for making other kinds of charts. One could be done using 'feely' words on one axis and names of colors on the other. These types of activities are intended to help students inspect and describe the object they have found and to see that there are different ways to describe a single item.

fuzzy							X
Crispy						X	
Prickly					X		
Bumpy				X			
Smooth			X				
Squeezy		X					
Fluffy	X						
	Fluffy	Squeezy	Smooth	Bumpy	Prickly	Crispy	Fuzzy

Color and Change

An Environmental Investigation

BY
NATIONAL WILDLIFE FEDERATION
MINNESOTA ENVIRONMENTAL SCIENCES FOUNDATION, INC.

Children are naturally curious. Sometimes there is a gap between their innate curiosity and the type of inquiry-behavior which teachers seek to foster. This gap is unnecessary. We can direct and channel curiosity without stifling it by helping children use their curiosity to develop definite skills. Perhaps the most important of these skills, in terms of developing inquiry-behavior, is that of **observation.**

Children spend a lot of time exploring their environment--watching, listening to and touching those things which attract their attention. **Color and Change** tries to help children bridge the gap between "seeing" and "observing". To do that, children are asked to observe certain objects carefully. their attention is then directed toward one physical property of the objects--**color.**

Color is an important property of natural materials. Often, color change is an indication that a significant reaction has taken place within an object. The brown of bruised apples or bananas is evidence of injury; the color of ripening fruit indicates maturation. One of the goals of this unit is to help children become aware of events in their environment and interested in protecting the objects they have learned about.

The activities of this unit have been drawn from Science--A Process Approach, and elementary science curriculum developed by the American Association for the Advancement of Science, and the MINNEMAST Elementary Science and Mathematics project.

INTRODUCTION

Color change dramatizes the fact that nature is a dynamic system in a constant state of flux. This phenomenon of change is apparent in North Temperate regions where natural colors appear and disappear, leaves and grasses grow and die, and where life forms undergo mass migration in response to the seasons.

Consider, for example, the deciduous trees in your area. Leaves develop from buds which have been in a resting state during the winter. The breaking of bud dormancy is dependent upon change--the length of the day increases, making more "sun energy" available to the buds; temperature changes occur, making conditions more favorable for water movement within the plant. A series of sophisticated chemical changes occurs because of energy relationships and environmental factors. The end result is the production of leaves.

Many shades and color combinations are evident in plant structure. Green, red, yellow and blue are the most common. These colors do not necessarily remain constant. The predominance of one or another pigment may shift according to **seasonal change**. Color change may also result from **interaction** within a natural material. For example, changes in fruit coloration can indicate injury or ripeness. The activities of this unit will help children realize the great variety which exists in the natural world, particularly in regards to color. They will also help the children perceive distinguishing characteristics and recognize similarities and differences in living things. In addition, the activities provide good opportunities for the development of communication skills.

We recommend that the unit be started in the early fall, soon after student return to school. One activity draws upon seasonal changes os it would be a good idea to begin before leaves change color. As an alternative to fall teaching, you might begin in the spring as leaves and flowers emerge. If possible, it is best to spread the section of the unit over the entire year so the students can continue to observe color change in different seasons.

The material in the unit is designed for grades K-2. Some of it may be more appropriate for one level than another. We hope you will tailor the activities to best suit your students' interest and to spark their enthusiasm about their surroundings. You might also want to consult **Nature's Part in Art** and **Nature Hunt**, two related units in this series.

MATERIALS

construction paper	gallon pot	paper towels
paper bags	gallon bottle	fruits and vegetables
tagboard	medicine	cellophane tape
shoe boxes	tap water	insect pins
paint	clear ammonia	paper coffee cups
drawing paper	hot plate	plant tags
red cabbage	Pyrex clear dishes	notebooks
vinegar	small, clear jars	crayons

Color and Change

Perception of Colors

The activities in this section are intended to help children recognize the primary colors (red, blue, yellow) and the secondary colors (purple, green and orange), as well as tints and shades of these colors. The aim is to get the students acquainted with color in their surroundings.

MATERIALS

construction paper-- (4 sheets each of primary colors; 4 each of secondary colors, plus 4 sheets of different tints, and 4 of different shades of the primary and secondary colors)
paper bags
tagboard
shoeboxes (about 12)

(Tint is color lightness, Shade is color darkness)

When all of your materials are spread out on a table, you should have about 12 sheets of primary and 12 of secondary colors. Also, 4 sheets each of two or three shades and tints of both color groups.

As a first step, prepare three shoe boxes: on the end or side of one, tape a piece of primary red paper, on the second, tape a piece of primary blue, and one of primary yellow on the third box. Next, from the remaining pieces of primary paper, cut out 2"x2" squares--about 50 for each of the three colors. Put all of these squares into one paper bag and shake the bag to mix the colors.

Next, cut out about 50 squares from each of the secondary colors, and 50 squares from the shades and tints. Put ALL of these in another bag and shake. Seat the children in a circle and place the three shoe boxes in the center. Take the first bag with the primary colors and scatter the pieces inside the circle. Ask them to put the pieces in the shoe box labeled with the correct color.

When the children have done this, bring out the second bag with the secondary, tint and shade colors. Now, dump all of the pieces of primary colors in this second bag, and shake well. Then scatter all these pieces around the circle, and ask the children to take one piece at a time and put it in the shoe box which comes closest to that color. Green might go in the blue box, and orange might go in the yellow. Tell them there are no right or wrong boxes--they should just put each piece where they think it goes. As a variation, you could hide the pieces around the room have the children hunt for them.

When all of the pieces have been placed in the three boxes, examine them with the children. Discuss, and 'vote' on the placement of any pieces in question. Children will probably remark about the orange, purple and green pieces. Since these colors are so common, the students may want to make more boxes for them. Bring out three more shoe boxes and ask the class which is the most "true green", "true purple" and "true orange". When one piece of colored paper has been chosen to represent each of the three colors, tape each piece to a shoe box. After the new boxes have been marked this way, groups of children may re-sort all of the pieces of paper into appropriate boxes.

As they work, the children should gradually become aware of an ordering or grouping of colors. Perhaps they could now arrange the boxes in order in a circle. Through discussion it may be decided that orange belongs between yellow and red, purple between red and blue, and green between blue and yellow. They still may not understand that secondary colors result from combinations of the primaries. This concept is not important now. When the boxes have been arranged in the circle, encourage the class to walk around the circle and name the colors.

Extend the activity by showing the class how to make their own color charts. Have them paste pieces of each six colors (three primaries and three that they chose as true green, purple and orange) on a piece of tagboard. This will give each student his own color chart and enable him to walk around the room identifying the colors of different objects through comparisons with his chart. The children will also see objects that come in many colors which they have not charted. Some students may notice brown, black and white are not on the charts, but are present in many objects. They can add these colors to their charts if they want.

Color and Change in Natural Objects--Indoors

Natural objects display a variety of colors. In this section the class will first describe and reproduce the colors of a collection of fruits and vegetables. Then they will observe the change that naturally occurs over a period of time in these items. Finally, they will work with natural pigments which have been extracted from familiar materials. The aim of this section is to get children aware of color as a <u>significant</u> characteristic of natural objects and to get them interested in <u>observing</u> changes that occur on those objects.

MATERIALS

paint--a jar of yellow, red, blue, black and white, for every two students
clear ammonia
drawing paper
shoe boxes from previous activity
vinegar--1 qt.
red cabbage
paper towels
hotplate
10-15 babyfood jars
heatproof, transparent containers--6
tap water
a variety of fruits and vegetables--one per student
medicine droppers
gallon pot
gallon bottle

A. Descriptions of Fruits and Vegetables According to Color

Display all the fruits and vegetables before the class. Ask them to identify them by name, and assign a color description to all items. If the object has more than one color, have them describe the dominate color. Bring out the six shoe boxes from the previous section, and have the class compare the colors of the objects with those on the boxes. They should place each fruit of vegetable in the box with the closest color. If there are still questions about color, make up another box with a question mark on it. This activity is intended to encourage the class to carefully observe the colors of the fruits and vegetables and to give them experience in grouping by color.

B. Observations of Color in Fruits and Vegetables

This activity will illustrate two diverse concepts: 1--colors may be mixed to produce other colors, and 2--fruits and vegetables vary in color and shape not only between types, but within a type.

Lay large sheets of paper on the floor and provide every two students with red, yellow, blue, black and white paint. Pass out one fruit or vegetable to every child. Ask each to paint a picture of his piece on the paper, trying the copy the color. Since the children only have primary paint colors, they will find some difficulty in reproducing

the exact color. Have them mix colors to find the correct combination. They might exchange their papers and make another drawing using another piece of fruit. They should find that color differences not only exist between types, but also within a certain type of fruit or vegetable. One orange can be green, while another is orange.

C. Observation of Color Change in Fruits and Vegetables

Give each child a clear container which can be sealed tightly (plastic bag, jar with lid). Ask each child to put into the container the last piece of fruit he had. He should seal the container and put his name on it (use a portion of the object if it is too large).

If they painted several items, have them put an 'X' next to the one they put in the container. Display the paintings near the containers of fruit. Place the containers where they can be easily seen by the children. Ask each student to watch his piece over a period of days. Obvious changes will occur within a week. After that, all objects will change rapidly. Some will develop very interesting molds, some very pretty. All fruits will decompose in about six weeks. The class may want to record this process with other painting of their pieces. You may also want to discuss the changes taking place. Use the data sheet at the end of this activity to record the changes in each fruit or vegetable.

D. Pigment Magic

In this section, the children will word with several chemical solutions which have very definite and obvious reactions when mixed. The reactions will produce different colors, tints and shades, depending not only upon which solutions are mixed, but also upon what quantities of these solutions are mixed.

The activity will stress the need for careful observation and record-keeping. After the initial activities in this section, it will become especially important for the class to keep precise records of the amount of each solution needed to make a certain color so that they can later reproduce that color.

1. Ammonia, Vinegar and Red Cabbage

Before class time, boil a broken-up head of red cabbage in a gallon of water for ten minutes. Pour the resulting colored water into containers of about 1 cup, making enough for teams of two. Next, pour two inches of household ammonia into a gallon bottle. Fill the remainder with warm water. Provide each team with a small jar full of this solution. This dilute solution is not very dangerous, but caution should still be used when working with it, especially for younger kids. Rinse eyes with water if it gets in.

Fill a third set of jars with vinegar, again making enough so that each team of two children has one. Mark the three solutions so that they can be told apart. They are referred to as A - ammonia, B - vinegar and C - cabbage water here. In addition to the jars of three solutions, each team should have six eyedroppers and as many small transparent containers as they can gather; 10 - 15 would work well for this activity.

DAY ONE - INTRODUCTION TO SOLUTIONS

Ask the children to use their empty containers to mix portions of solutions A,B,C in any combination and order they wish. Brilliant colors will appear as they do this. Use the droppers for mixing small amounts. As a color is formed, put it in a new jar and set aside. Do this for each new color made. Encourage adding tints and shades of colors to this new collection. The resulting group will include pinks, greens, lavender, yellows, browns.

The children will uncover two problems while doing this activity. First, when they discover a new color, they may want to make it again. This will only work if they haven't contaminated solutions A,B,C. It is important for them to use one dropper for each of the colors, and not to use the droppers in different containers. The solutions will have changed color if it is contaminated. Allow them to discover this problem on their own, and to correct themselves. The first day is to experiment with.

The second problem while trying to reproduce colors will be that they forget which solutions were used to get a certain color, and how much was used, and in what order they were mixed. Let them figure out how to avoid this problem on their own.

DAY TWO - CONTAMINATION AND RECORD KEEPING

The class has experimented for a day with various solutions and assorted problems. Today, ask them how they have corrected the problem of contamination. Should they use one dropper for each solution, and not mix them up? They could label the droppers A,B,C to match the solutions.

Next discuss how they might overcome the problem of forgetting the type, amount and order of solutions used to make different colors. Can they think of a way to record kinds, amounts and order of solutions used? Have them devise a system of record-keeping by using the letter of the solution and numbers for the amount of droppers full of each: Example -- two droppers of A and three droppers of B = green -- this could read as 2A + 3B = green. At the end of this section is a data sheet which can be copied for the class to use in their record keeping.

Ask the class again to produce as many colors, shades and tints as they can, but this time taking care not to contaminate the solutions. They must also keep records of their 'formulas'. Each time a new color is added to ~~the~~ collection, the formula should be written on or near the jar on a piece of paper.

DAY THREE - REPRODUCING COLORS

Have the children work in pairs. Each pair may select one of the colors from yesterdays class collection and try to reproduce that color by using the formula written on the paper. Each child in the pair should work alone trying to get the color. Have them hold the colors next to a white sheet of paper to compare.

When both members of the team have closely reproduced the color in one jar by following the formula, they could exchange their jar with another team. If neither member can get the correct color, they should examine their technique; are they following the formula? are their solutions contaminated? If they still can't get the color, then assume the written formula was incorrect. Then they can experiment to find what the correct formula would be.

2. Other Pigment

When the children have finished working with the cabbage water, tell them how the water was colored by the pigment being boiled out of the cabbage. Tell them some pigment will not come out when boiled in water. For example, plant chlorophyll will only come out when boiled in alcohol. Ask the class if they think they could find other plants which might have pigments that would come out when boiled in water. They might bring in such things as flower petals, leaves, vegetable and fruit rinds. Boil these to see if the color will change as the cabbage water did.

Color and Change in Natural Objects--Outdoors

Color and changes in the natural world are often observed by children, especially when the seasonal difference in foliage becomes apparent. But leaf change is only one example of a natural color change. This section of the unit demonstrates to the class that color change is widespread and significant.

BEST COPY AVAILABLE

MATERIALS

paper bags, 1 per child	cellophane tape	notebooks
paper coffee cups - 12	several large sheets of	white paper
insect pins	plant tags - 50	crayons	plastic bags

A. Color as a Distinguishing Characteristic of Natural Objects

Give each child paper bag and head outdoors (playground, park natural area). Ask the children to bring back examples of as many different colors as they can by collecting natural objects they find. Stress that the items should be natural. Tin cans, balls, etc. should be excluded. If they wish to bring back part of a living plant, please only bring a small part, and one that won't be obviously missed. Make it into a contest to insure that a lot of colors are collected. If at school, have them lay the items out on the table; otherwise, have them spread the items out on a light sheet of paper outdoors.

First, have them make a list of all the different colors they found. Then make a list of all the different kinds of objects brought back. Such a list might include: flowers, rocks, leaves, bark, grass, soil etc. They might now make a more complete study of the different colors each of these items exhibits. To do this, each child can collect two or three more examples from around their home. A table could be divided and covered with paper in the class to provide room for each object: leaves in one section, rocks in another and so on. Attach items with tape, and have students write their names next to objects they collected. Leaf and other plants should be examined within two days or they will dry and crumble.

> **ASK THE CHILDREN: Are all the leaves green? All the leaves the same shades and tints of green? Do leaves from the same plant have the same color? Do young, small leaves have the same color as larger, older ones?**

You could do the same with sections of tables for branches and concentrate on the color of bark. Have students bring in samples of branches from home (see **Plant Puzzles**). Soil offers an interesting collection of colors, often not thought of by children as anything other than brown. Flowers and rocks can also be studied this way; keep flowers in jars of water, rocks on white paper. All of these objects are best when viewed with hand lenses.

B. Color and Change Over the Year

Prepare the class for a field trip around the school grounds, or to a natural area. Give each child a small plastic bag and a plant tag to write his name on. Outside, have each child choose a plant for investigation. Each child can fasten his tag on the plant, and then slip the plastic bag over it to protect it. Close the top tightly with a rubber band.

Tell the class they will be observing their plants throughout the school year. They will also be discussing and comparing whether or not their plants change during that period of time. By continuing this part of the observation over the year, a complete color cycle may be seen. You can arrange monthly observation and reports so the class remains involved. They could even keep journals or records of the changes occurring.

You might have the children make drawings of their study plants with crayons or paints. If they do, have them try to duplicate closely the colors, beginning with the first day until the end of the year. Try to get them to predict what will happen to their plants as time passes. Do they anticipate color change? Have them make a second drawing of what they expect it will look like in a month. Painting and drawing can be a good activity for early fall. This could be done either in or outdoors.

Display the artwork so the class can see the results. As the year progresses, place the different drawings of the same plant side by side for comparison.

Extended Activities for the Class

Will green leaves change color when placed in a cold environment?
Collect some maple or aspen leaves before they turn color. Place them in a plastic bag in the refrigerator. Have students observe any color changes.

Will a banana ripen as quickly if it is stored in a cool place?
Take four bananas that are not completely ripe. Place two of them somewhere in the room and two in the refrigerator. Have the class note the date and observe and record color changes daily.

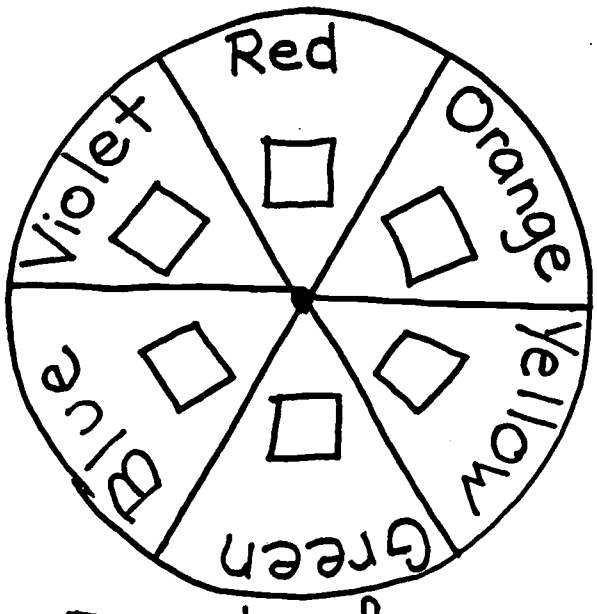
Will evergreen branches change color if they are brought inside?
Clip some branches from fir or pine trees and bring them to school. Put the cut end into sugar water, and have children observe changes.

What changes occur in people as they grow older?
Have the students bring in several photos of them at different ages. Discuss the changes that have occurred since the photos were taken.

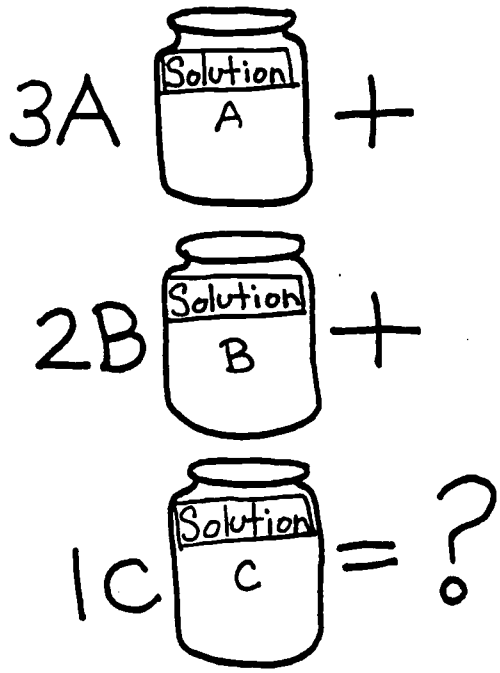
Are there hidden colors in washable black ink?
Contrary to popular belief, chlorophyll is not the only pigment found in green leaves. The autumnal shift in color is not a mystical chemical process. In most instances, it is the result of alterations in pigment predominance. Chlorophyll is lost as the day-length changes and the unmasking of other pigments occurs.

Have the class each place a drop of washable black ink on a piece of mist filter paper or paper toweling. All of the colors which make up black ink will be revealed in the rings spreading out from the initial drop. If all the children use the same ink, the color rings will be the same on all papers. Have them compare their rings and name all of the colors showing.

ASK THE CHILDREN: Does everything have color? Is color important? What different things can color change indicate?



Example of a Color Chart



Reproducing Colors

MOLD DESCRIPTION CHART

Type of Fruit _____

DATE	DESCRIPTION

COLOR FORMULA CHART

Name, number or letter given to new color	Sample of color *(apply sample in each square)*	Formula for color

Plant Puzzles

An Environmental Investigation

BY
NATIONAL WILDLIFE FEDERATION
MINNESOTA ENVIRONMENTAL SCIENCES FOUNDATION, INC.

A jigsaw puzzle is a complete picture that has been cut up into pieces. The picture has a patter. It might be one of blue sky and barn and green grass with a lake in the distance. We can use the pattern or the organization of the picture, as well as the shape of the interlocking pieces, to help put the picture back together. Recognizing the pattern of the picture makes the reconstruction easier.

All natural objects also reflect a pattern or structural organization. The objects themselves can be thought of as complete entities or made up of parts. The parts might be seen as pieces in a natural puzzle. Together these parts form an organized and somewhat predictable system.

This unit aims to help children become familiar with some of the characterizing patterns of natural objects. By learning more about patterns in a particular object, the children should come to a better understanding of the object itself. Then, that object, whether it be a leaf, tree, flower or snowflake--will begin to stand out against the background of all other things around them.

This unit is meant to be fun. Our hope is that in learning about what goes on around them--the contents and the workings of nature--children will appreciate their environment that much more and will want to protect it.

INTRODUCTION

Plant Puzzles aims to familiarize children with patterns in nature. To accomplish this, children will inspect a number of branches. They will examine the external structures and characteristics, as well as the internal pattern of the stem. Through these activities, some of the relationships between external and internal patterns will become apparent. For example, the children will see that a branch causes an interruption of variation in the internal pattern of the stem; or that the number of rings in cross sections of a woody stem decreases from the bottom to the top.

The children will examine external features of branches such as buds, leaf scars, the bark color and texture, pores in the bark and leaves. Buds are found at the point of leaf and stem junctions and are the forerunners of branches, leaves and flowers. Bark is essentially a protective covering for a plant. Pores form on the bark for the passage of gases to and from the living tissue. The pores are really conspicuous on smooth-barked branches, and appear as tiny, hard 'pimples'.

The internal pattern of the branch will be revealed by cutting the it with pruning shears. The ring pattern seen in the cross section is formed from different types of tissue which provide support and serve to conduct plant nutrients up and down the stem--out into the branches, leaves buds and flowers down to the roots. Usually one ring is added for each of growth.

During the activities of this unit, each child will make a puzzle out of a branch. After exchanging their plant puzzles, the class will try to reconstruct their classmates' branches, using knowledge gained through observation of branch structure and patterns.

All the activities and the natural items discussed in this unit are intended to be suggestions. We hope you will use the unit as a starting point for further investigations into other patterns which Nature offers.

MATERIALS

pruning shears (1-6)	quart milk cartons, 1 per child	
large cardboard box	cardboard string tags	water
shallow cardboard boxes	to hold milk cartons	tape
box rubber bands	handsaw	

Plant Puzzles

Collecting the Small Branches

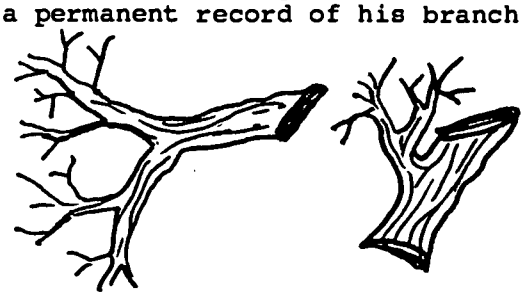
MATERIALS

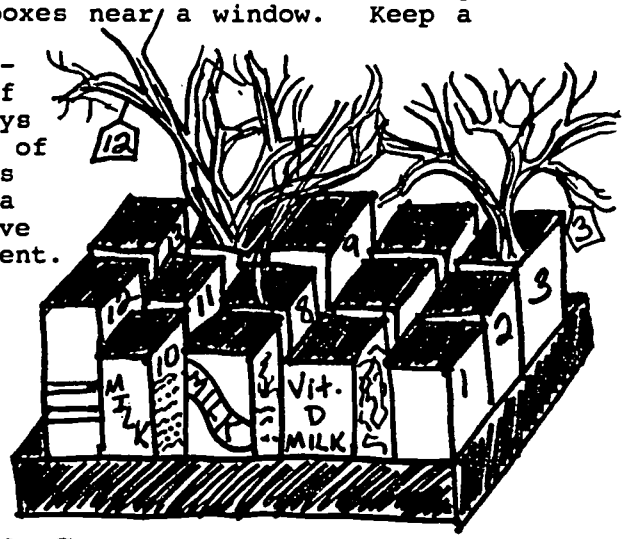
cardboard hangtags tape water quart milk cartons
large cardboard boxes (1 per child)

If these activities are started in March or early April, the children will be able to see leaves and flowers appear from buds on the branches they collect. Ask each student to bring in 2 branches from home. These should be: a) as long as his arm, b) come from the same tree or bush c) be interesting. You might want to use the note at the end of this unit to send home to parents so they are aware of what the children will be doing, and to assist them in getting branches.

When the children have brought in their branches, have them select one to watch bloom or leaf out. The other branch will be handled a lot and eventually cut up. Each child can put both of his branches in his milk carton. These should be numbered consecutively. Give each child two name tags--one for each branch. On one side have him write his name, and on the other the number of the milk carton. Make the numbers large so they can be seen across the room.

The cartons can be placed in rows in large cardboard boxes so they don't tip over. During those times when the branches are not being investigated they should be kept in the boxes near a window. Keep a little water in each carton.
The leafing-out branches--marked with tape--can be left in the cartons throughout all of the activities in this unit. During the days ahead, have each child make periodic checks of his leafing out branch. He can compare buds with the other branch. If each child keeps a chart of the changes he detects, he will have a permanent record of his branch's development.





Observing Small Branches in the Classroom

1. **What Branch Am I Thinking Of?**

A. Have each child remove the branch without the tape from his milk carton and place it on his desk.

B. Walk around the class and make a mental note of one of the branches. Without pointing or telling the children which branch, describe some of its characteristics: color of bark, size, buds, color, etc. You might mention how many buds, smaller branches, position, etc.

C. Have the children guess whose branch you are thinking of.

This activity starts the children looking at the outer appearance of their branches.

2. **What Do The Branches Look Like?**

A. There are several pages at the end of this unit which can be copied and made into a booklet for the students. Pass out one book to each student. The students can fill in the charts and drawings by examining their own branches. The booklet pages have their own directions to follow.

B. Have each child check the first three pages of several other booklets by exchanging books and branches. If there is question about a book, encourage discussion with the book's owner. Initial each booklet checked.

3. **Finding The Bottom Piece Of The Branch**

Materials: box, branches, pruning shears

A. Using the pruning shears, cut one inch off the bottom of each child's branch (the one without the tape). Collect the pieces in a box. Gather the students around a table.

B. Spill the pieces from the box on the table; see if they can find the piece cut from their branch and try to match to the ends.

C. See if the pieces can be fitted onto its branch exactly as it was before the cutting.

This activity emphasizes the bark color. As the children try to match the cut ends they will also have to look more closely at other characteristics of the bark and possibly at the ring pattern exposed by the cut.

4. **Making A Radio Broadcast**

Materials: TV carton, box bucket containing branches
tape recorder amplifier (optional)

A. Remove the bottom and one side of the card board box and place it at the front of the room with the open side facing away from the students. The box should be large enough so that a bucket of all the class' branches can be place inside.

B. Place the amplifier in front of the box so the microphone is on the open side of the box. You now have a 'broadcast station'.

C. Gather up all of the branches used in the previous activities--the ones without the tape--and put them in a bucket of water inside the box out of view of the class.

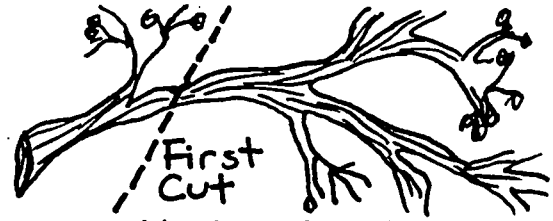
D. Take the individual milk cartons which all still contain one branch and place them around the room, so they and their numbers are seen.

E. Have one child get behind the box, take out a branch, and describe it over the microphone. If a child in the class feels he knows which branch it is, he raises his hand. The correct answer gets to be the next broadcaster. Encourage use of terms learned up to this point in describing the features of the branch.

5. **Making a Plant Puzzle**

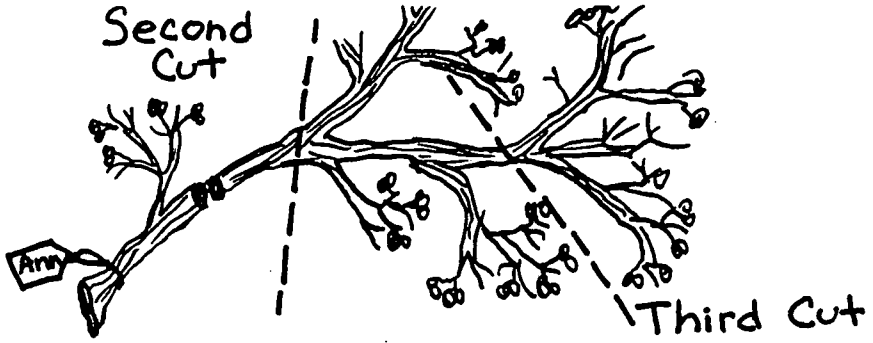
Materials: pruning shears, paper, branches, nametags, rubberbands

A. Have the children predict what they think the cross-section of a branch will look like when it is cut, like this:



Have each child make a circle and inside the circle draw what he thinks the cross section will look like. As each finishes his drawing, he should raise his hand you can cut his branch with the shears. (the branch without tape)

B. Have him draw what the branch really look like now he can see it, and compare with his first 'guess' drawing. Then have the students draw a picture of what they think the branch will look like when cut again, further up the branch. As each student finished the second drawing, again you will cut the branch. They will again make a real drawing to compare with the first guess.



C. If time permits, have them draw and cut three more times.
D. Pass out rubber bands. Each child should attach a name tag to the rubber band on the branch pieces. This is the plant puzzle.
E. Have them exchange puzzles and see if they can reconstruct the branches.

This activity gets the student to start looking at internal characteristics and patterns and how these patterns change in relation to the external characteristics they have been studying.

Observing Big Branches

MATERIALS

Large branches or small trees handsaw

A. Get some large branches, either from a nursery, lumber mill or commercial tree trimmers, or from a local forest if permitted. Try to get a variety of types. Put a tree coating material over the cut ends. These will be used to make more puzzles.
B. Using the handsaw, cut the branches into pieces about one to two feet long, having no more than four or five parts to the puzzle. Try to make the cuts across points where smaller branches, leaf buds, injuries or growth is noticed.
C. Put the pieces form each puzzle in a bag. Assign one bag to a team of students. Have them reconstruct the branch or tree. If you have made several puzzles from one branch, they should find the other puzzles to make the complete branch.
D. Discuss the varying internal patterns the children found. Can they tell why the pattern is so different in a pot where a branch has formed when compared with a spot where there is no branch?
E. Have the groups exchange puzzles. What comparisons can be made between internal patterns of different types of trees?

Additional Activities

1. Rooting of Branches

The branches of some trees and bushes will take root when they are cut and placed in water. If you would like to observe this, have the students begin the activity in the early spring, after the hard freezing of winter but before the buds start to open.

Not all kinds of plant will root. This activity can be a comparison in which the children try to discover the kinds of plant that will root from the twigs of branches.

About a 1 or 2 foot section of branch should be cut off, the lower twigs or sub branches trimmed and the branch put in a can of water. If this is set near a window, the twig buds and maybe flower buds will open. After this happens, the roots will appear as fuzzy white growths under the water. Such trees as willow, poplar, some shrubs and dogwood will root this way.

2. Where Do The Trees Branch?

Different kinds of trees and bushes have different branching patterns, and even in winter it is possible to recognize trees from their shapes. The students might find it interesting to photograph the silhouette pattern of trees against the sky or to reproduce drawings and see if they can distinguish between the various branching patterns. Some trees branch high off the ground, others spread sideways, and some bushes have branches that start from the ground, while trees have only one main stem.

Studying the shapes of trees and observing their silhouettes can be quite interesting. Tree design might be worked into good art project with various tree shapes serving as components of an artistic design. While doing activities of this type, you may want to ask the class what influences they think can change the pattern of tree growth.

3. Counting Tree Rings

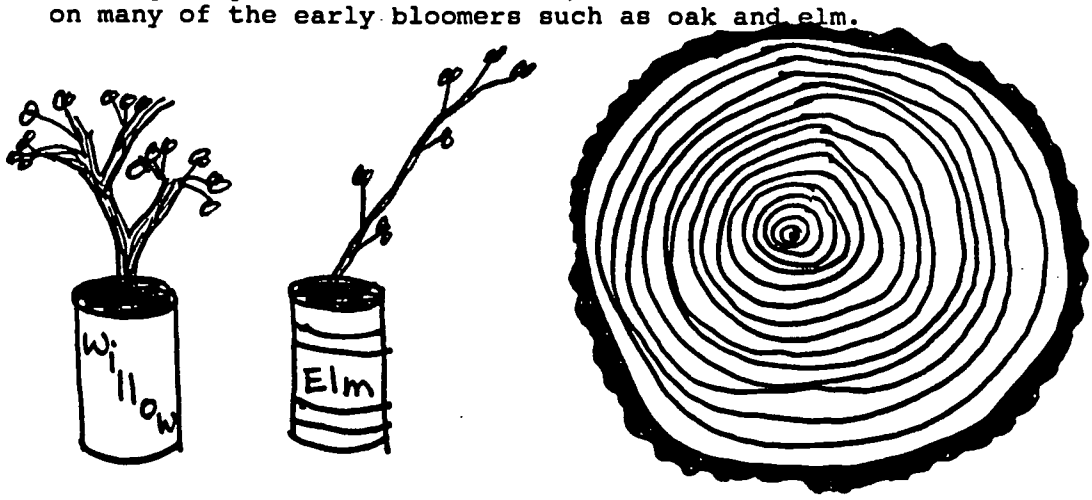
Counting ring patterns on a cross-section of a tree trunk or branch will give a good idea of the age of the tree at the point where the rings were counted. Most children enjoy this activity.

Ring patterns on hardwood trees and slow-growing trees are going to be small and sometimes difficult to count. Large trees with soft wood like poplar, cottonwood, pine have large growth rings that are easy to count. Generally, a tree adds one ring of growth each year. In most cases, it will be made up of light and dark bands. The light band is in the spring wood and shows how much it grew. This band will be larger than the summer wood, which will be darker and narrower. Since the bottom of a large tree's trunk is much older than a higher branch, it will have more rings. The students will soon find that the small twigs often are one year's growth.

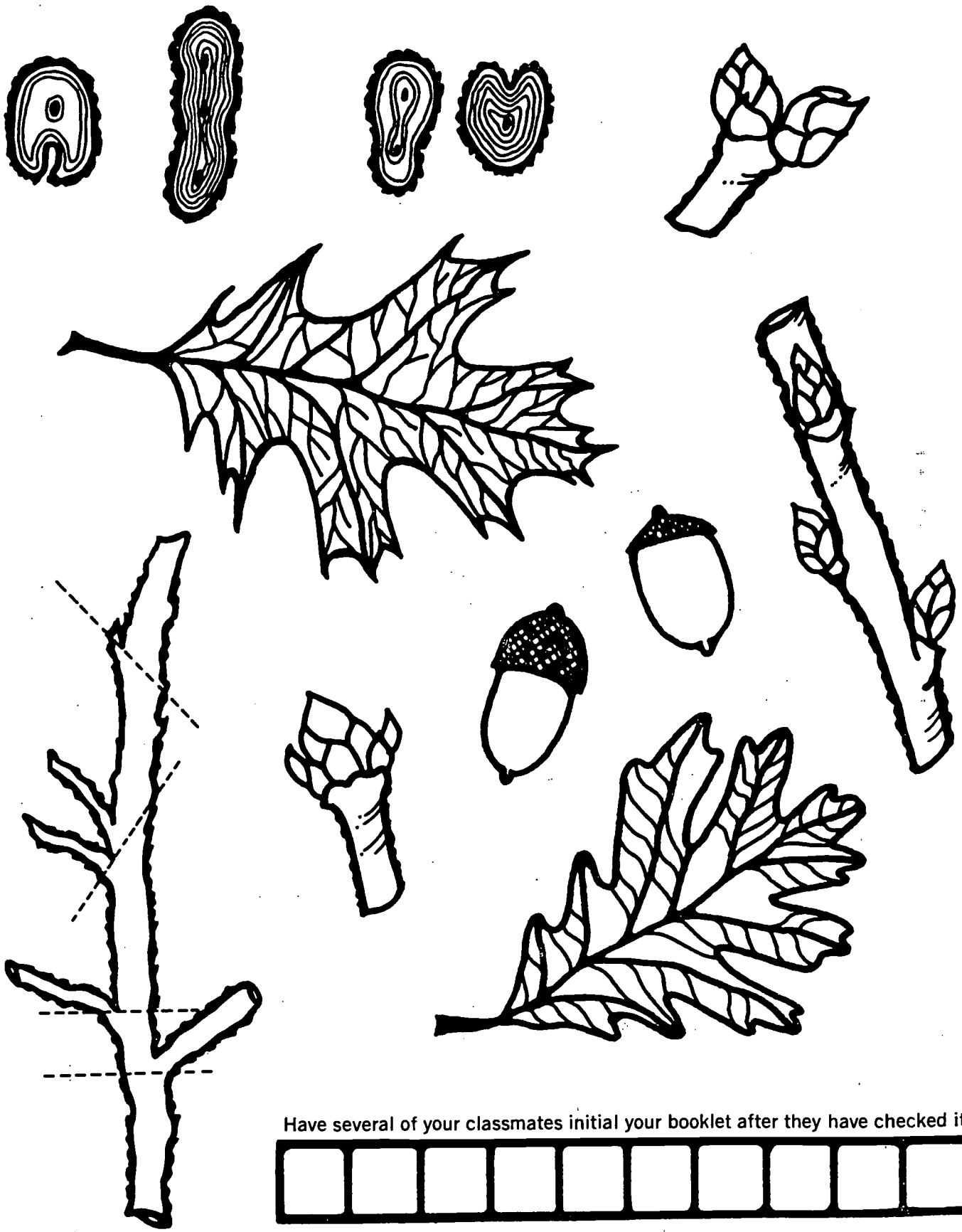
The tree ring activity might start with the children counting the rings from their plant puzzles. It could proceed to a class activity using a branch larger than any of those used so far in this unit. Perhaps one of the students' has access to a branch being cut off a large tree, or the school is cutting down a tree on the grounds. If they could all watch the limb being removed, they would be able to count the rings in it. If possible, have the tree cutter cut the limb into 1 foot lengths to take back to the class. This way students can check rings from the smaller branches to the larger ends, and can use this for a discussion.

4. Observing Buds

Another interesting comparative study would be for the children to see what the buds become. Buds on branches do not always turn into leaves. It could be a twig full of leaves or a flower. Some leaves turn into petals and sepals. Buds form different plants turn into different looking twigs and leaves. Often, the flowers will come before the leaves on many of the early bloomers such as oak and elm.

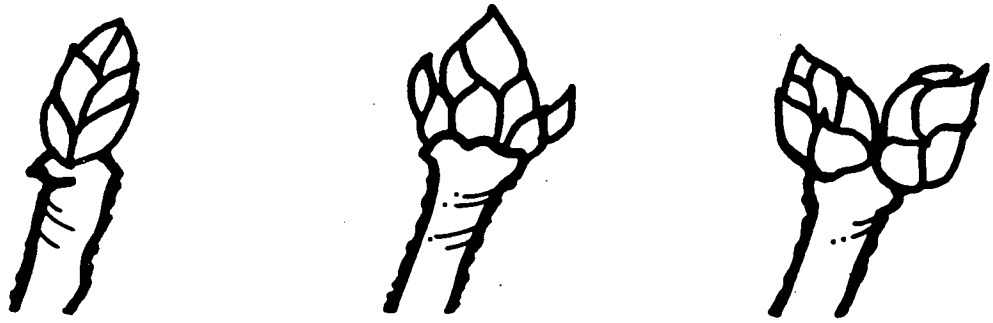


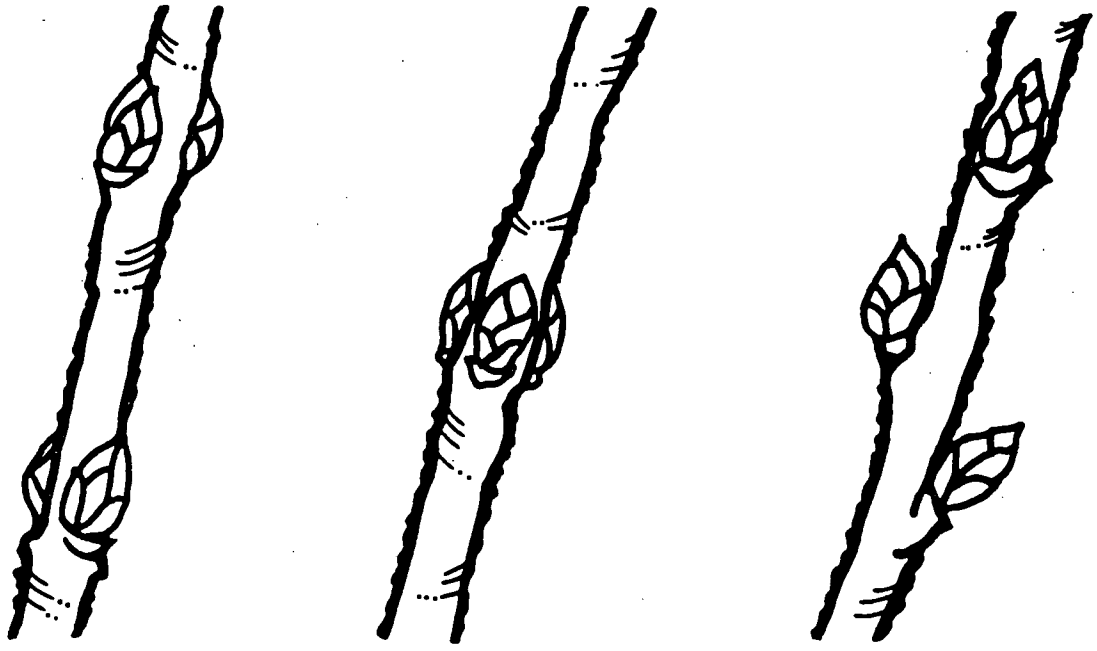
BRANCH BOOKLET



Have several of your classmates initial your booklet after they have checked it.

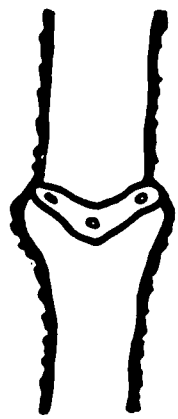
Circle the bud which looks most like the bud on the end of your branch. Circle the branch which has an *arrangement* of buds most like the arrangement on your branch. Draw a picture of the bud at the end of your branch, in the box at the right.

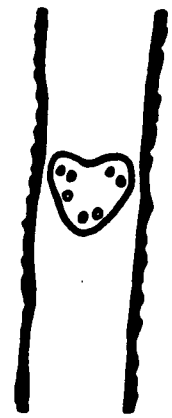




Circle the *leaf scar* that looks most like the leaf scars on your branch.
Draw a picture of one of the leaf scars on your branch, in the box at the right.











1. Do this page when leaves come out of the buds on your branch.
2. Take a leaf from your branch and trace around it, making an outline of the leaf.
3. Look at the leaf closely. What do you see? Draw what you see inside the outline of the leaf.

Make a drawing of your branch on this page. First tape the branch to the top of your desk so it will not move. Draw just the side of the branch that faces you.

Water: Who Needs It?

Living Organisms' Dependence on Water

BY
OREGON STATE UNIVERSITY SEA GRANT COLLEGE PROGRAM
OREGON DEPARTMENT OF EDUCATION

The educational concept of this unit will show the students that water is an integral part of our daily lives and that all living organisms need and depend on water for survival. People depend on water for life; Water, the incomparable compound, supports all life.

Water: Who Needs It?

MATERIALS

pencil, crayon, felt marker rock plant
shoe book Kool-Aid or dry mix drink
classroom animal, or picture of one copy of worksheet
2 tagboard charts--1 titled NEED WATER, the other DO NOT NEED WATER

Allow about one class period for this activity, or 30 - 40 minutes. Begin this lesson after recess if possible. Assemble the class for a discussion. The talk could go as follows:

How many had a good time at recess? Raise your hand if you played hard. What happens to your body when you play hard? (Out of breath, get tired--direct towards feeling thirsty, etc.) How would you feel if it was a very hot day and you played hard? (Sweaty, thirsty). When you feel thirsty, what is your body telling you it wants? Does your body really need water? What does your body do when it is real hot outside? Why would your body sweat? How many of you have run through sprinklers or jumped in a pool when you were really hot? Did your body feel cooler afterwards?

Explain to the class that when the body sweats, it is cooling off. It is actually water coming out of your skin. So when you feel thirsty, your body is telling you, "I need more water." The water your body lost needs to be replaced.

Do all people need water? (Yes) Is there anything else in the world that needs water? Take out the rock, plant, shoe, Kool-aid, animal or picture and book and spread on the table. Ask if any of these objects needs water. Accept all reasons from the discussion. Bring out the two titled tagboard charts, put in front of the class. Have one or two students keep track of how many things the class comes up with to fit the two categories. Write them on the appropriate chart. If there is disagreement, have the children discuss their answers and why.

We know that we need water just to live. Are there any other reasons why we need water? Let the class make their own suggestions. Some possibilities include:

1. We need water for safety. Fireman, etc.
2. Water can be fun. Recreational activities, etc.
3. Water helps to keep us clean and healthy.

Pass out worksheet #1 to each child. Have them draw a circle around all the things that need water on this page. You may have to start with them, but let them finish on their own, and turn in.

Later, when they are done, go over the page as a class. Ask for reasons why certain items are circled. This page should bring out the idea that both living and nonliving things need and use our water supply.

Additional Activities

1. Have the children look through old magazines for pictures of things that do need water and pictures of those that don't. These can be pasted on the tagboard charts by the written objects.

2. Have a table where the children can come and experiment with measuring water. Have various metric containers available if possible. Also, have paper towels handy for spills. You could leave this set up and incorporate it into math lessons.

3. Place a stalk of celery in colored water to enable children to see that plant actually absorb water.

4. Begin a **Water Work Chart.** With felt marker write all words covered in lesson that had to do with water: water, thirsty, drink, sprinkler, sweat, swimming, boating, etc.

5. Take a field trip to a fire station.

6. Invite a fireman to come to class and talk about fire safety and the use of water.

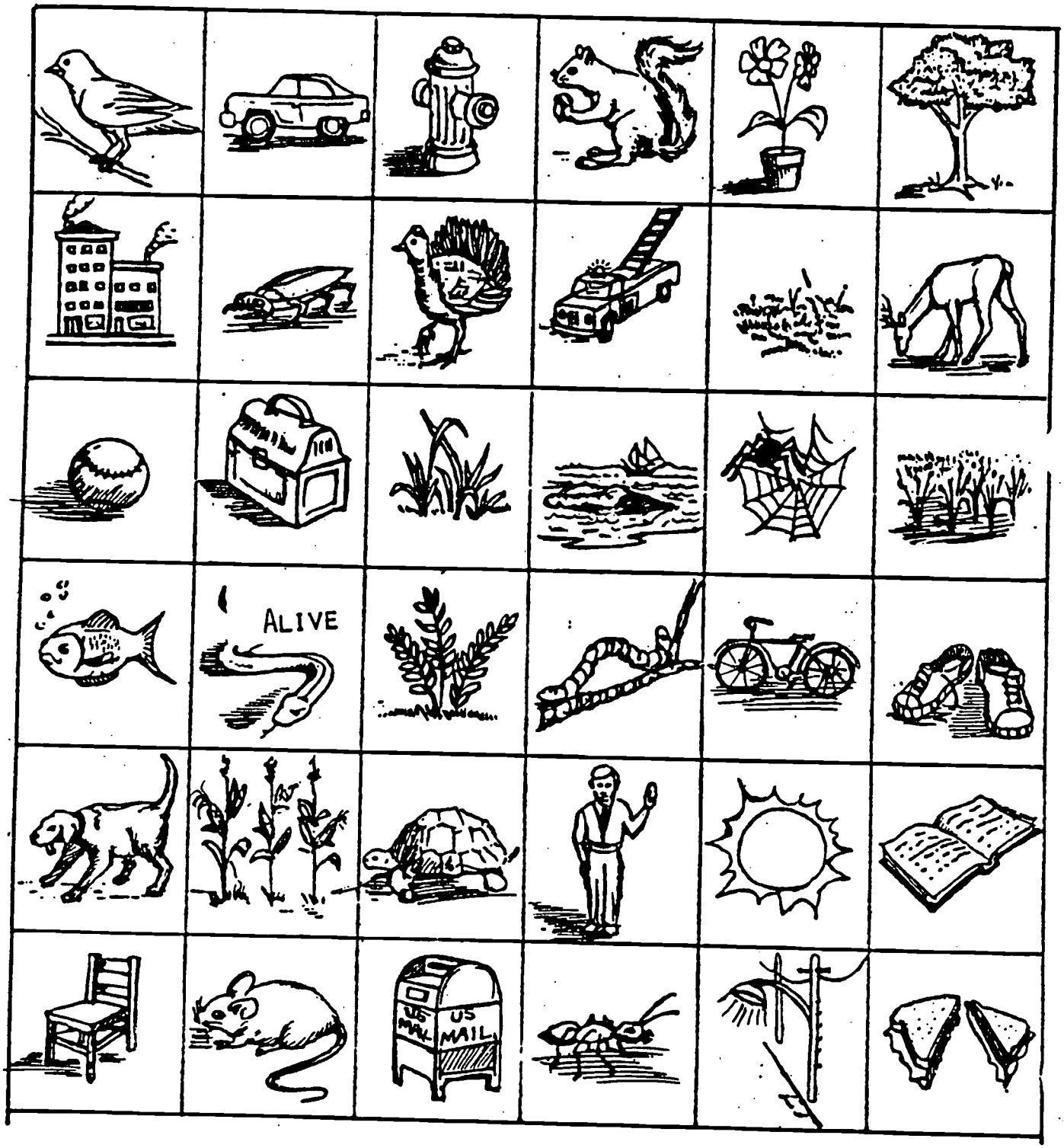
7. Language Experience: Have each student say or write a sentence or two on "How I Use Water," and then make a picture. A fun idea is to record on a tape player each child saying his way of using water. Put the pictures in a booklet with the tape in a pocket inside the cover and you have a free time learning center activity.

Source: Adapted with permission from "We Need Water," Water-McGrath Pak, Project ECOLogy, Highline Public Schools, Department of Instruction, P.O. Box 66100, Seattle, WA

NAME _____

WORKSHEET #1

Circle all things which need water.



Studying Your Town's Use Of Water

Water Use and Treatment

BY
OREGON STATE UNIVERSITY SEA GRANT COLLEGE PROGRAM
OREGON DEPARTMENT OF EDUCATION

Water is a resource none of us can live without. Water has endless uses, and yet today we seem to be taking its availability for granted. As demands for water increase, we must utilize our water resources carefully since there is only so much available at any given time.

In this unit, students will begin to understand the concepts of water use, which are: a) People depend on water for livelihood; b) People manage and use water for residential and industrial needs.

The following exercise contains a series of questions designed to stimulate discussion and raise more questions. It can also be used as the basis for a class project. Students will be able to estimate the impact of his or her town's use of its local water supply. Total time needed for this activity is one class period, or about 45 minutes. No materials are required.

Studying Your Town's Use of Water

Where does your town get its water? Have the class find out from the city government about how much water your town uses on an average day, in the summer, and in winter. Plot or write your answers in the following manner:

Town's Water Source_____

Average Daily Use (summer)_____

Average Daily Use (winter)_____

Is your town's water measured in any way? For example, is the amount you use measured with a meter? If so, how does this prevent water from being wasted?

Is your town's water treated in any way?_____

_____

How is this done and what chemicals are used?_____

_____

Find out how much water your household uses in a day or month. You can figure out what the major uses of water are in your household by taking a few simple measurements. For example, a toilet uses about 7 gallons of water time every time you flush it. Can you figure out how much water is used for the following?:

1. Bath or shower_____
2. Clothes washer_____
3. Dish washer_____
4. Garden and lawn_____
5. Drinking and cooking_____
6. Other uses_____

Does the water leave the house in the same condition as it came in? How has it changed? What happens to the waste water after it leaves your house? Is there a sewage treatment plant in you town? If not, then where does the water go? Why? If the sewage is treated, what kind of treatment does it receive and where does it go after treatment? Locate these places on a map of your town.

Source: Adapted from All Around You, An Environmental Study Guide, U.S Department of the Interior, Bureau of Land Management, Washington, D.C., 1976.

Water For Fun

Recreation and Clean Water

BY
OREGON STATE UNIVERSITY SEA GRANT COLLEGE PROGRAM
OREGON DEPARTMENT OF EDUCATION

The educational concept set forth in this unit is that people depend on water for inspiration; water provides places for thought and fun. The students will be able to show ways in which water recreation is dependent on clean water and some effects of pollution on recreation.

There are many outdoor recreational opportunities upon water. Swimming, fishing, boating, surfing and water skiing would not be possible without water. The proximity of attractive bodies of water enhances the recreational potential of land for camping, hiking and nature trails.

According to the National Recreation Survey of 1962, the following percentages of the U.S. population engaged in water-related activities:

Swimming--45%	Boating--22%	Sailing--.12%
Canoeing--.11%	Water Skiing--6%	Fishing--29%

Of course, the changes in lifestyles, work habits and income in the past 30 years have resulted in even larger numbers of the American public using water recreational facilities.

The quality of water, including the amount of pollution, appearance, odor, and rate of flow are among the factors that determine whether or not it is usable for recreation. Many bodies of water in this country and the world are in danger of becoming unusable for recreation because of the deteriorating quality of the water and its adjacent land.

In and around cities, there are large concentrations of people and industries requiring such services as waste treatment and electricity. Often these utilities cannot accommodate the demand. It is then that chemicals and untreated sewage are dumped into the waterways. The chemicals affect the water bodies by killing many of the organisms living there.

The bacteria which normally live in water increase in number in response to the organic material in untreated sewage. They act to decompose the sewage and, in the process, utilize much of the dissolved oxygen in the water. The condition of the high organic content and low oxygen content is know as eutrophication. The bacterial population also increases due to the tremendous amounts of bacteria contained in human wastes. Thus, the bacteria in water have two detrimental effects: 1) they consume a great deal of oxygen during eutrophication so that other organisms are deprived of the oxygen they need to exist, and 2) they cause a dangerous health hazard to both humans and wildlife as a result of a high coliform bacterial count.

Industries and electric power plants often require water as a coolant. In the cooling process, water which is usually taken from lakes, rivers, and estuaries is warmed and returned to the body of water from which it came. Many of the organisms cannot tolerate these temperature increases and die.

Oil is being used today in tremendous quantities. In order to get more of this needed resource, new drill sites are being investigated. Some of these proposed sites are in the Pacific Ocean, directly off the West Coast of the United States. If there were to be a drilling disaster, such as the one in Santa Barbara in 1969, the beaches would be covered with oil, severely limiting recreational activities. Much oil is also being transported in ships which pass through waterways near recreational areas. In the process of ship loading, transport, and unloading, large amounts of oil are spilled. This spilled oil, usually concentrated in port areas where refineries are located, also can adversely affect the wildlife and recreational potential of an area.

Water pollution is not limited to highly populated areas. Many rural farm areas use chemicals, fertilizers, insecticides, and herbicides which, through rain runoff, are carried to streams, lakes, estuaries, and coastal waters. In these areas, wastes from both humans and livestock are often not treated and also run off into surrounding water bodies. The chemicals, insecticides, and herbicides can be toxic to organisms, thus upsetting the ecological balance. Fertilizers promote the growth of aquatic plants in large numbers. When these plants die, eutrophication occurs.

Erosion of soil from rain and running water is a natural process, but its rate is increased by human activities such as deforestation and improper farming techniques. The silt that is formed from the erosion of soil can fill up and thus reduce the lifespan of a body of water. The silt can also cover the food supply and nesting areas of fish and shellfish.

As more people participate in water recreation, there is a rapid development of recreational areas, which results in a sharp increase in pollution. Often land development occurs so rapidly that there is little thought given to improved waste treatment facilities or the ecological effects of homesite building. For instance, vacation homes are sometimes built on tidal marshes, areas of high biological richness and sensitivity to environmental disturbances, with little consideration for the environmental impact.

What can be done to conserve our water resources? Most importantly, people should become aware of the pollution problem. This knowledge would serve a two-fold purpose: people would be more conscious of their effect on the environment and they would be able to work with public officials to improve municipal pollution control facilities and to plan for future population growth and the resultant increase in pollution. Also, more scientific research should be supported to develop better pollution control facilities, alternative forms of energy, and to investigate the environmental consequences of pollutants. Finally, laws can be enacted to ban the more deleterious pollutants. Of the pollutants not banned, the laws could limit the amounts and locations of their disposal.

It must be realized, however, that many industries, farms and utilities which contribute to water pollution are of great economic importance to the country. Thus a compromise must be reached which allows for maximum protection of the environment compatible with economic and industrial growth.

Procedures:

1. Present students with maps of their state or ask them to bring one from home. (These can be road maps from oil companies.)

2. Ask students to identify bodies of water on the map (in blue).

3. Ask them to identify places that they know on the map. One student and the teacher can lead the activity with a map that all can see and compare with their individual maps.

4. Have pupils locate bodies of water they have visited and tell what they did there. The discussions should bring out the fact that most bodies of water are visited for recreational purposes. Fishing, swimming, boating, water skiing, and others will be mentioned.

5. Show pictures of water recreation. Examples are:

   Ranger Rick's Nature Magazine

   July 1970 - cover
   Nov. 1970 - p. 7 (canoeing)
   Jan. 1970 - p. 17 (ice fishing)
   Dec. 1970 - p. 20 (nature walk)
   Aug./Sep. 1969 - p. 27 (kayak boating)

   or any other outdoor or nature magazine. Many of the nature and conservation magazines will have good pictures for this purpose.

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6. Ask the students to describe how the water looks in these pictures.

7. What things pollute the water (make the water dirty and unusable)? It is important that the students understand as many of the causes described in the teacher background as their level of comprehension permits. In this way, they will become aware of man's detrimental effect on the environment.

8. Show pictures of polluted waterways and compare these to the pictures from #5. Examples are in National Geographic Magazine:

   June 1971 - p. 866
   Dec. 1970 - p. 738

   Also many of the weekly news magazines, such as Time and Newsweek, from the early 1970s have good pictures for this purpose.

9. Ask the students whether they have ever gone to a beach only to find that swimming was not allowed. Why do they suppose this could happen? Answers may include health and aesthetic reasons: the water is not pretty; it smells; it has garbage or chemicals in it; it has oil in it; the bacterial count is high.

10. What part do people play in pollution? (More people, more pollution.)

11. Can you foresee the possibility of public swimming areas being limited to a set number of people per day? Why?

12. Find out the population of your county and determine 50% (half) of this figure. What would happen if 50 percent of the population of your county decided to go to Fogarty Creek State Park all at once on a summer Sunday? (50% of the U.S. population now lives within a 2-hour drive of our coasts.)

13. What can we do to limit the pollution of the marine environment?

Additional Activities:

1. Draw a large outline of your state on 4' by 6' paper. Have committees of children place symbols for recreation on the water areas. They may draw their own pictures of boats, swimmers, fishermen, fish, clams, oysters, etc.

2. Give each student a copy of the enclosed "Blue Water Bay" map and pollution factors cutout sheet.

   a. Have the students color the pollution factor symbols with colored pencils and cut out the squares.

   b. Have the students place the boat, surfer, and fishing rod cutouts wherever they think they might be found.

c. For every four of the cutouts in "b." that they can place on the water, they must also put one gas pump, garbage can, and car in appropriate places. For every six of the cutouts in "b." they must put one farm and factory in appropriate places.

d. Ask the students what they have found out by using the "Blue Water Bay" map.

Source: Adapted with permission from Water for Fun, Coastal and Oceanic Awareness Studies Learning Experience 104, Marine Environment Curriculum Study, Marine Advisory Service, University of Delaware, and Population-Environment Curriculum Study, College of Education, University of Delaware, Newark, DE, 1974.

Resources: For Language Arts Supplement: Bagnall, Norma, Sea Sources: Bibliographic and Resource Material of Children's Literature of the Sea, Texas A & M University Sea Grant College Program, College Station, TX, 1981.

Language Arts Activities Supplement

WATER FOR FUN

Unit Overview: The recreational uses of water and the manner in which pollutants affect these uses are investigated. The unit includes activities such as viewing and naming bodies of water on maps, learning how bodies of water are used and what pollutes them, and making and labelling maps.

Grades 1-3

Pocket Full of Syllables--Learning Center (or board activity)

Objective: To have the child recognize one-, two-, and three-syllable words and to follow written directions.

Materials: Index cards with one-, two-, and three-syllable words from the "Water for Fun" learning experience written on them.

A large poster or bulletin board with four pockets on it, labeled "1," "2," "3," and "Word Cards."

Answer card at teacher's desk.

Procedure: Put the following directions on the learning center and go over them with the class.

1. Take the cards out of the Word Cards pocket.

2. Read the word on the first card.

3. If the word has one syllable, put it in the pocket with the #1 on it.
If the word has two syllables, put it in the pocket with the #2 on it.
If the word has three syllables, put it in the pocket with the #3 on it.

4. Do the same for each word card.

5. When finished, get the answer card from my desk.

6. Check the words from pocket #1 and see if they match list #1 on the answer card. Do the same for pockets #2 and #3.

7. Did you put them all in the correct pockets?

8. Now mix the cards up and return them to the Word Card pocket.

9. Next, return the answer card to my desk.

10. Thank you.

WATER FOR FUN (continued)

Grades 1-3

Suggested Words:

One syllable	Two syllables	Three syllables
rain	killing	chemicals
clean	fishing	industry
oil	nature	canoeing
spill	protect	pollution
swim	water	erosion
sail	garbage	factory

Sentence Making--Learning Center

Objective: To help develop good sentence structure

Materials: Five small "category" boxes or cans to hold cards
List of words or phrases lettered on cards
Paper, pencils, crayons
A corner or area where learning center can be set up

Procedure: Put the following directions in the learning center and go over them with the class:

1. Choose a card from each category box.
2. Put the cards together to make a sentence.
3. Copy the sentence you made.
4. Draw a picture to go with the sentence.
5. Write your name on your work.
6. Pin your work up if you wish.

Suggested words and phrases:

Category 1	Category 2	Category 3	Category 4	Category 5
The beautiful	duck	jumped up	quickly	in the car.
The funny	dog	floated	slowly	on the mountain.
The wise	crab	leaped	nicely	in the woods.
The thoughtful	butterfly	hobbled	beautifully	in the ocean.
The silly	godmother	yelled	eagerly	in the corner.
The cheerful	king	slept	sadly	in the classroom.
The ungrateful	teacher	smiled	gleefully	over the curb.
The frisky	magician	ran	roughly	up the street.
The yellow	shark	crawled	noisily	at the store.
The black	scientist	stumbled	recklessly	through the tunnel
The spotted	clam	wiggled	doubtfully	at the beach.
The wicked	rabbit	shook	carefully	on the leaf.
The ugly	monkey	swam	happily	under the bed.
The clever	fish	skipped	gracefully	across the lake.

Now You See It--Now You Don't

The Hydrologic Cycle

BY
OREGON STATE UNIVERSITY SEA GRANT COLLEGE PROGRAM
OREGON DEPARTMENT OF EDUCATION

In this unit, studentswill continue with the main concept of water supporting life, and people depending on water. Students will be able to explain why water evaporates and condenses, and what part the seas play in the hydrologic cycle.

The earth loses water to the air and receives water from the air in a cycle. The seas serve as major reservoirs for the water. It is a **hydrologic cycle**, a water cycle. From the surface, water moves into the air as vapor. As the air rises, the vapor is cooled. As the air cools, it won't hold as much vapor, and some of the vapor condenses to form microscopic droplets which we recognize as clouds or fog.

When many microscopic droplets are present in the air, they collide and form larger droplets. When these droplets are heavy enough, they fall as rain, snow, hail or sleet. The precipitation is collected in creeks and rivers and returned to the seas to complete to cycle. Much evaporation also takes place from lake, river and puddle surfaces--anywhere moisture is accumulated. In a process called transpiration, plants take up some of the water and release it directly into the air as water vapor. This activity will help explain to students how the hydrologic cycle works.

Life on earth would be impossible without water; human activity, even going to school, depends on it.

Ask students where rain comes from. They will usually point out that rain comes from clouds. Ask where clouds come from. You may have to explain that clouds are made up of microscopic water droplets. Without answering your question about clouds, have several students investigate answers to these questions:

How does water get into the air to form clouds?

> Have a student put a wet spot on the blackboard with the sponge or make a wet handprint and watch it. It will disappear because the water evaporates. Where does the water go? (Into the air.)
>
> Discuss how the water changes to a vapor (gas). Explain that this happens when things dry out. The water evaporates. This process takes place at the surface of all bodies of water, large or small.
>
> Ask if there is any way to make water evaporate faster. Allow students to try out a few ideas. They will probably try fanning it or heating it. Both wind and heat speed up evaporation.

How does the water change back to a liquid to form clouds? How can we get water vapor in the air to change into a liquid? Or, could we find a way to get a glass lid wet without dipping it in water?

> Heat a Corningware dish with a little water in it on a hot plate without the lid. Have students place the lid in a refrigerator or freezer. As the dish starts to warm, place the lid on it. Students will be able to observe water droplets forming on the lid.
>
> Caution: BE SURE TO INSTRUCT STUDENTS TO KEEP HAIR, CLOTHING, AND HANDS AWAY FROM THE HOT PLATE.
>
> Discuss why condensation droplets formed on the glass lid. (Water vapor contained in the warm air condensed as the air cooled against the cold lid.) Point out that evaporation and condensation are opposite processes. Then discuss the cooling of air as it rises from the earth. You may want to point out that land obstructions such as mountains force air to rise, cool, and drop some of its moisture (see illustration on next page).

Having seen that water will condense out of the air, can we duplicate this process by forming microscopic droplets (fog or clouds)? To establish that condensation occurs initially in very small droplets, have students in teams of 2-3 fill a bottle or jar with hot water. The hotter the better. Caution: THE HOTTER IT IS, THE MORE POTENTIAL DANGER FOR STUDENTS. After about one minute, remove all water to a depth of about 4 cm. Hold an ice cube in the mouth of the bottle. You may want to use a dark background to observe more easily the resulting "fog."

Discuss why warm air at the bottom of the bottle rose and what happened when it neared the ice cube. As the air cooled, some of it condensed into water droplets and the fog was formed.

You may want to use an overhead projector to tie these processes together, or ask students to make models of the water cycle using cutouts (see illustration on next page). You may have them write stories of a water droplet, perhaps personified, as it goes through the hydrologic cycle. Or have them draw a picture illustrating as many examples of how water gets into the air as possible.

Additional Activity:

Build a solar still to show how the processes in the hydrologic cycle can be utilized to produce fresh water.

Source

Adapted from Marine Science Units and Activities for Preschool Primary, and Elementary Grades by Billy G. Lewis and John C. Serwold, Shoreline Community College Marine Science Institute, Seattle, WA, 1971.

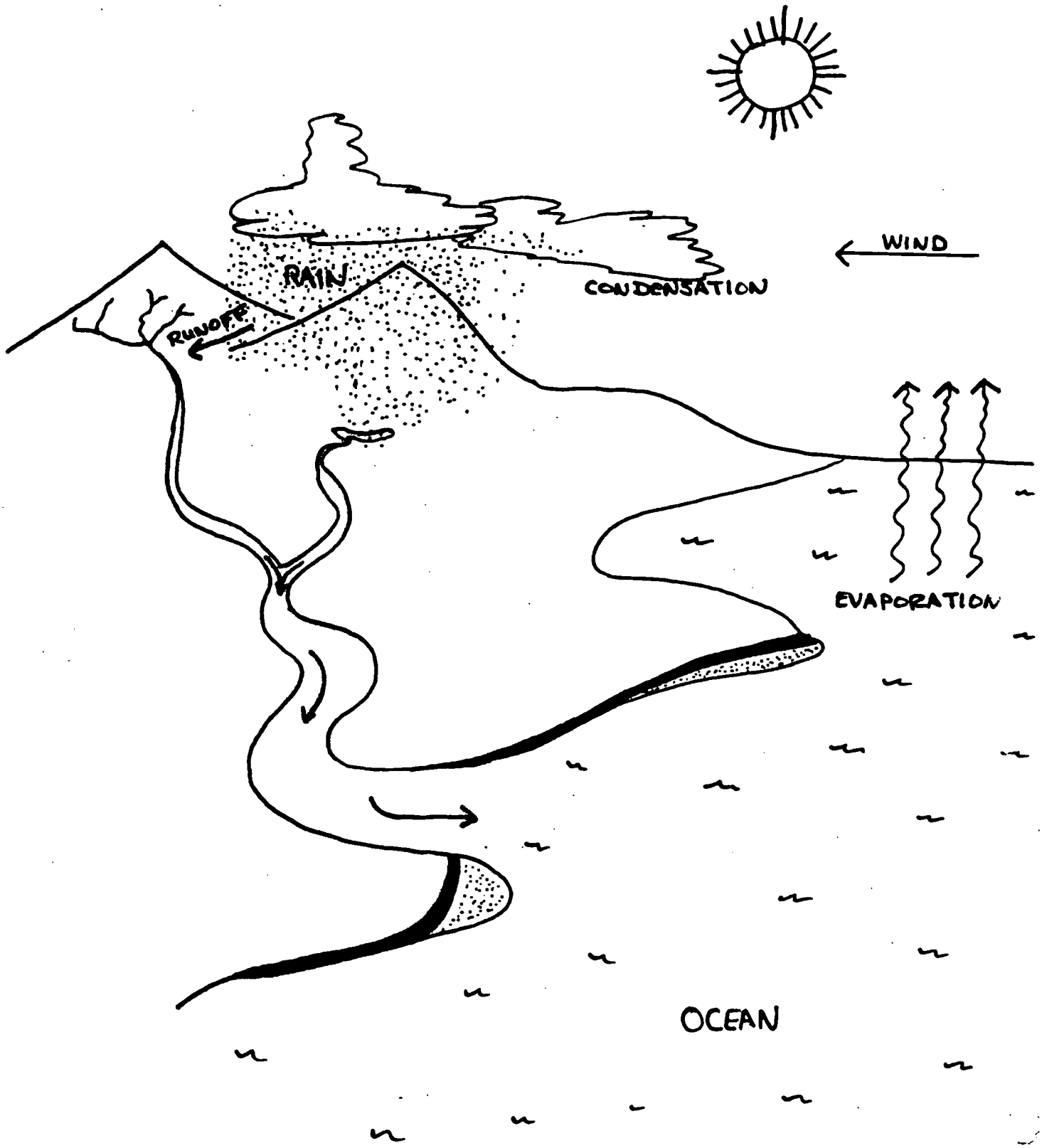
Resources

Elements of Meteorology. Second Edition by Albert Miller and Jack C. Thompson, Chalres E. Merrill Publishing Co., Columbus, OH, 1975.

Weather, A Golden Guide by Paul E. Lehr, R. Will Burnett and Herbert S. Zim, Golden Press, Western Publishing Co., Racine, WI, 1965.

Water by Jo Ellen McGrath, Project ECOLogy, Highline Public Schools, Seattle, WA.

HYDROLOGIC CYCLE




COTTONWOOD CREEK
NATURE TRAIL

Plants in the Classroom

An Environmental Investigation

BY
NATIONAL WILDLIFE FEDERATION
MINNESOTA ENVIRONMENTAL SCIENCES FOUNDATION, INC.

Plants are frequently grown in the classroom, and many of the plants used in this lesson will already be common classroom occupants. In this project, however, we go one step further than the usual process of growing classroom plants.

Ecology is the study of the interrelationship of living things with other living things and with non-living things. This unit is concerned with introducing ecology to children, as well as with the way in which a child approaches ecology. As the concern is twofold, so is the purpose of this lesson: (1) the class will investigate the interrelationship of their plants with the environment by discovering the required amount of light and water, room for growth, and type of soil; and (2) they will learn that they can control the variables in the plant's environment, and must do so to arrive at valid conclusions. The latter is vital to any science investigation, but could easily be unknown or ignored by children.

INTRODUCTION

Children often see plants and plant seeds either outdoors or in the classroom. As teachers, we often tell them three things about growing plants:

1. **Plants need soil.**
2. **Plants need water.**
3. **Plants need sunlight.**

We direct the children to "put it by the window," "water it every day," etc. Often we neglect to tell them that the soil contains food for the plant in the form of minerals, that the water carries the food to the leaves, and that the sunshine converts the food into growth energy.

The following activities and experiments with plants and seeds include six distinct types of plants.

1. **A cutting from a house plant.**
2. **Carrot tops grown in water then soil**
3. **Sweet potatoes grown in water.**
4. **Red and white potatoes grown in soil.**
5. **Bulbs grown in pebbles.**
6. **Seeds - germinating, grown in soil, etc.**

If you simply wish to grow these six types of plants in the classroom, the children can gain a knowledge of care, growth patterns, and differences in plants.

If you also wish to have the children develop an understanding of experimentation, variables in an experiment, record-keeping, and the use of data in reaching understandings, then the unit activities will be of invaluable assistance.

The suggested records to keep for each activity are indicated in the text. Full page copies of the record sheets are furnished in the back of this unit so that you can remove them and copy them for the children.

MATERIALS

baggies
water
toothpicks
blotter paper
nut cups
pots
jars
low bowls
coffee cans
2 and 3 lb.
toweling
soil - black, sandy
clay, commercial
red and white
potatoes
large houseplant-
philodendron, etc.
sponges
low containers
(tinfoil trays)
construction paper
large spoon
milk cartons
knives
carrot tops
ruler
sweet potatoes
string
bulbs
paper plates
pebbles
low, transparent
containers
wild bird seed
bean seeds
pea seeds
corn seeds
measuring cups

PLANTS IN THE CLASSROOM

ACTIVITIES

I. PLANT CUTTING

MATERIALS

philodendron plant
transparent containers - (e.g. jars)
soil
water
string, ruler
construction paper

Keep a philodendron plant in your room until you are ready to begin this activity.

* Divide the class into small groups - perhaps classroom rows.
* Provide each group with a transparent container.
* Have a group member fill it with water.
* Have members from each group:
  a) take a cutting from the plant (be sure each group gets an end cutting),
  b) place the cutting in a transparent container,
  c) identify the container with a numeral or name.
* Have each group select a location in the room for the container, place it there, and make a clear note of it.
* Have each group keep the container well filled with water.
* Have each student watch for rooting.

ASK THE CHILDREN:

About the different ways the plants are being handled (location in room).

About the similar ways the plants are being handled (containers, amount of water, time for watering).

About the differences in the plants themselves (some cuttings are larger)

Have each group (hopefully this idea will come from a member of the class) measure the total length of the cutting by using a piece of string and placing it on a ruler, in addition to noting the number, length, and width of the leaves. An interesting way to record this would be in picture form. Have the children carefully trace the cutting on paper and record its measurements along the side-length of cutting; width of the leaf or leaves; length of the leaf or leaves.

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* When the roots are two or three inches long, have each group plant its cutting in soil. Make sure the containers are identical, (A peanut butter jar would be an appropriate size.)
* Use the same kind of soil for all the plantings so that you can have a controlled experiment. You may want to use black top soil from someone's yard or a "black magic" type of commercial soil.
* Plan how much water each plant will receive and how often it will be watered. Plan to water every day-enough to keep the soil moist.

You now have cuttings which are rooted similarly in the same kind and size containers, with the same soil, and plans to water the same amount each day. At this point your class is ready to conduct an experiment testing the need of sunlight.

ASK THE CLASS:

About the similar ways that these plants are being handled (containers, soil, watering plans).

About what is similar but not exactly the same (the plant itself)

About other needs that a plant has which we can vary and thus test (need for sunlight).

* Have each group select a location for its plant which will have a describable degree of sunlight. If a group wants to, it can place its plant in a dark place, but don't force this or any other choice which is involved. It is important that the students think up and execute their own experiments. If you want to insure that a plant growing in darkness is tested, make an extra cutting in the beginning and test this yourself. Explain the concept of scientific controls to the class.

* Have them record information each week on their record sheets. (Copies of record sheets for duplicating are found at the back of this activity.)

* Have the class plan a comparative chart and fill it in from their group records.

ASK THE CLASS:

About the light needs of this type of plant.

About any factors that may have influenced the results (heat, forgetting to water, etc).

Whether they could better control an experiment and how.

* Have each group keep their plant in its location and continue to watch it grow. Continue recording as long as there is interest.

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II. Carrot Tops

Materials

carrot tops
shallow containers
soil-many different types
water
construction paper

* Have children bring in carrot tops.
* Place each top in a shallow container.
* Put in enough water to come to the top of the carrot pieces.
* Permit to grow.
* Measure and record growth.
* When the carrot tops are about three inches tall, have them transferred to soil. Vary the soil types by trying to use at least four different kinds: sand; clay (try your school art clay); black soil (from a yard); and commercial soil.
* Keep other variables constant: same type of containers; same amount and pattern of watering; same location.
* Have each planting labeled as to group of students, soil type, etc.

III. Sweet Potatoes

Materials

sweet potatoes
tall transparent containers
water
toothpicks
soil-(optional)
construction paper

* Have children bring in sweet potatoes. Be sure you have at least one potato for each group.
* Have groups place a whole sweet potato into a tall transparent container. Add water until only half of the potato is submerged. The potato can be held up by inserting toothpicks into three of its sides and resting them on the top edge of the container. If the children wish to plant potatoes in soil or any other substance, encourage them to do so.
* Have the children place the seed potatoes in different locations-try to vary these a great deal (i.e., one in direct sun, one in a dark closet, etc.).
* If there is difficulty in initiating the growth of the potato it may be that a growth deterrent spray was applied to the potato prior to its marketing.
* Another possibility is the fact that there are definite "spurts" and "lags" in a sweet potato's growth, and luck may be against you. Since it will be difficult to determine the reason, just begin with another sweet potato if growth will not start. For records, have the children sketch a map of the room, numbering the locations. Then have records kept by date and sprout length.

ASK THE CHILDREN:

About the best conditions for sprouting a sweet potato.
About the best conditions for growing a sweet potato.
About other conditions that influence the growth.

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IV. POTATOES

MATERIALS

red and white potatoes
knives
toweling
baggies
water
coffee cans - 2 lb
many types of soil
construction paper
measuring cups

Divide the class into five groups. Each group will conduct their own experiment with the potatoes, and each group will need at least one red potato and one white potato. Ask some children to bring in potatoes-or ask each child to bring one of each kind.

Group 1 - Moisture and Sprouting
* Cut each potato into several pieces, each piece including a few eyes.
* Place a portion of each kid of potato in the following places:

In a **sunny** place - on a **dry** piece of paper towel, inside a baggie.
- on a **wet** piece of paper towel, inside a baggie.
In a **dark** place - on a **dry** piece of paper towel, inside a baggie.
- on a **wet** piece of paper towel, inside a baggie.

Group 1 will have eight pieces of potato to study, four white and four red. If the children wish to add their won experimental conditions, be sure to encourage them to do so.
* Mark each potato piece with its location, date, and group.
* Add water to the moist pieces when necessary.

Combine records at the end of the experimental period and present to the rest of the class.

ASK THE CHILDREN:

About the effect of environment on the potato sprouting.

Group 2 -- Potato Growth and Soils
* Have the children bring in white and red potatoes.
* Have the children bring in two-pound coffee cans in which to plant the potatoes.
* Have the children cut their potatoes into several pieces -- as many pieces as there are coffee cans. They may, of course, plant a whole potato in a can. In fact, this is a good opportunity to make many varied tests, for potatoes and coffee cans should be plentiful.
* Have the children plant the pieces from both potatoes in at least four soil types (sand, clay, black dirt, and commercial soil), eight plantings in all.
* Make sure the children keep the sunlight and watering the same.
* Have the children check for first sprouting, height of plant, and general growth pattern.

Growth record sheets appear at the end of this activity. Display these records near the growing potatoes so that the whole class can watch this experiment and discuss it later. When the records have been completed, discuss the following with the children.

ASK THE CHILDREN:

About the soil in which potatoes sprout first.

About the kind of soil in which they grow the largest.

About height vs. thickness in respect to largeness.

Group 3 -- Water Needs for Potato Growth

* In two-pound coffee cans, plant pieces of red and white potatoes in the same kind of soil. Let the group select the type of soil it wishes to use.
* Vary only the water. Let the students decide how many different amounts of water they will check. Since they are using two-pound coffee cans, they might use 1/4 cup per day, 1/2 cup per day, 1 cup per day, and two cups per day.

ASK THE CHILDREN:

About the amount of water needed for the best growth.

Why the potatoes were all planted in the same size containers.

About the "constants" of the experiment.

Group 4 -- Sunlight Needs for Potato Growth

* Have children bring in a red and a white potato, and at least six coffee cans.
* Select the type of soil you want to use for each piece (probably black soil).
* Cut each potato into three pieces and plant in the coffee cans.
* You are going to text sunlight needs for growing potatoes so you will keep the other variables constant: container size, soil, amount of water, and frequency of watering.
* To check the sunlight needs, have one of each kind of potato in the sunniest spot in the room, another in the center of the room, and a third (both red and white) at the far side of the room, away from windows.

ASK THE CHILDREN:

About sunlight needs.

If this test is complete enough to really determine sunlight needs.

About other light conditions that could be tested.

Group 5 -- Container Size and Growth of Potatoes

MATERIALS

red potatoes
white potatoes
8-10 different size containers:
- 2 babyfood jars
- 2 peanut butter jars
- 2 2-lb. coffee cans
- 2 3-lb. coffee cans
- 2 large containers, if possible

graph paper

* Cut each potato into several pieces. Since you are testing for the influence of container size on final potato growth, keep other variables the same -- soil, sunlight, frequency of watering. However, adjust the amount of water to the size of the container, making sure to keep the soil equally moist in all the containers.
* Record growth and display for class use.

* Graph the growth patterns as follows:

babyfood jar	-------
peanut butter jar	.....
2-lb. coffee can	xxxxxxx
3-lb. coffee can	ooooooo
larger	+++++++

The rest of the activities in this unit can be planned by the children. It is a good idea to have each child work individually, for this will enable his activities to provide a basis for evaluation of his understandings.

1. Does the child develop a "valid" test?
2. Does the child test only one condition at a time?
3. Does he control other variables or does he need assistance?
4. Is the child able to cope with all the variables or does he need assistance?
5. Does he develop a clear set of records?

V. Bulbs

MATERIALS

several bulbs
transparent containers--low
pebbles

Bulbs can be planted by the entire class.

* Use them to decorate the room and to inform the children of yet another form of plant growth.

* To grow them, follow the planting directions which come with the bulbs.

* Encourage anyone who wants to make growth tests and record the results.

VI. Seeds

MATERIALS

bean, pea and corn seeds - 1 or 2 packages of each
wild bird seed, 1 box
blotter paper
nut cups
sponges
tin foil trays
paper plates
milk cartons

Lay a quart or half-gallon milk carton on its side and cut off the top side. Tape the opening closed and you have a planter. An option is painting the outside with tempera paint mixed with liquid soap.

A. Seed germination

* Divide the class into three groups. Each group will use one kind of seed.

* Have each member in the group set up seed germination conditions that are different from others in his group. Have the children consider the following conditions:

moisture
light
covering for container
temperature (keep refrigerated, etc.)

Each group should devise a record-keeping system for the rest to read.

B. Wild Bird Seed

* Give each child 1/2 nut cup of bird seed and a paper plate.

* Have them put the seeds on the plate and count, sort, etc.

There are broad ranges of activities possible with these seeds. Some are:
Find out what kind of plant each seed will become.
Find out the best soil for one of the seed types.
Find out the sunlight needs of one of the seeds.
Find out the water needs of one of the seeds.
Find out the growth pattern of the seeds.
Find out which kind of seed grows best when several are planted together.

EXTENDED ACTIVITIES

1. Collect mosses and liverworts from logs, soil or trees, and determine the care necessary to keep them alive and growing.

2. Grow mold on bread in various conditions: considering sunlight, dark, water, air, container, etc. Determine the environmental needs for mold growth.

3. Set up a mold garden or two with bread, cereals, fruit and vegetables, in a clear plastic hat or sweater box. It you set up only one, be sure to keep it well moistened; for several days vary the moisture.

4. Examine science textbooks in your school for interesting experiments e.g. extracting green from leaves by using alcohol, or testing for starch in leaves.





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Name _____

PLANT CUTTING

Record When in Water

	Beginning	End Week 1	End Week 2	End Week 3	End Week 4
1. Length of cutting					
2. Number of leaves					
3. Width of leaves					
4. Length of leaves					
5. Number of roots developed					
6. Length of roots developed					

Name _____

PLANT CUTTING

Record When in Soil

	Initial	End Wk. 1	End Wk. 2	End Wk. 3	End Wk. 4
1. Location of plant (next to window, under table, etc.)					
2. Length of cutting above soil					
3. Number of leaves					
4. Width of leaves					
5. Length of leaves					
6. Length of entire plant from top of leaf to end of longest root (optional since the plant will have to be removed from the soil and replanted)					

Name _____

CARROT TOP GROWTH				
	Initial	End Week 1	End Week 2	End Week 3
Height of Top				
Width of Top				
Number of Roots				
Number of Shoots				
Height of Shoots				
Date put in Soil				

Name _____

Group 1. POTATO SPROUTING RECORD SHEET

DRY RED	Date of Sprouting	Amount of Sprout	Sprout in three wks.
Sunlight			
Darkness			
MOIST RED			
Sunlight			
Darkness			
DRY WHITE			
Sunlight			
Darkness			
MOIST WHITE			
Sunlight			
Darkness			

Name _____

Group 2

POTATO GROWTH RECORDS

Amount of Water _____ Frequency of Water _____ Location in Room _____

RED POTATOES	Date of Planting	Date of First Sprout	Second Week			Third Week			Fourth Week		
			Ht.	No. Sprouts	No. Leaves	Ht.	No. Sprouts	No. Leaves	Ht.	No. Sprouts	No. Leaves
in sand											
in clay											
in black soil											
in commercial soil											
WHITE POTATOES											
in sand											
in clay											
in black soil											
in commercial soil											

Name _____

Group 3

WATER TEST FOR POTATO GROWTH

RED POTATOES	Sprouting Date	Second Week			Third Week			Fourth Week		
		Height	No. Sprouts	No. Leaves	Height	No. Sprouts	No. Leaves	Height	No. Sprouts	No. Leaves
¼ C.										
½ C.										
1 C.										
2 C.										
WHITE POTATOES										
¼ C.										
½ C.										
1 C.										
2 C.										

Name _____

Group 4

SUNLIGHT NEEDS FOR POTATO GROWTH

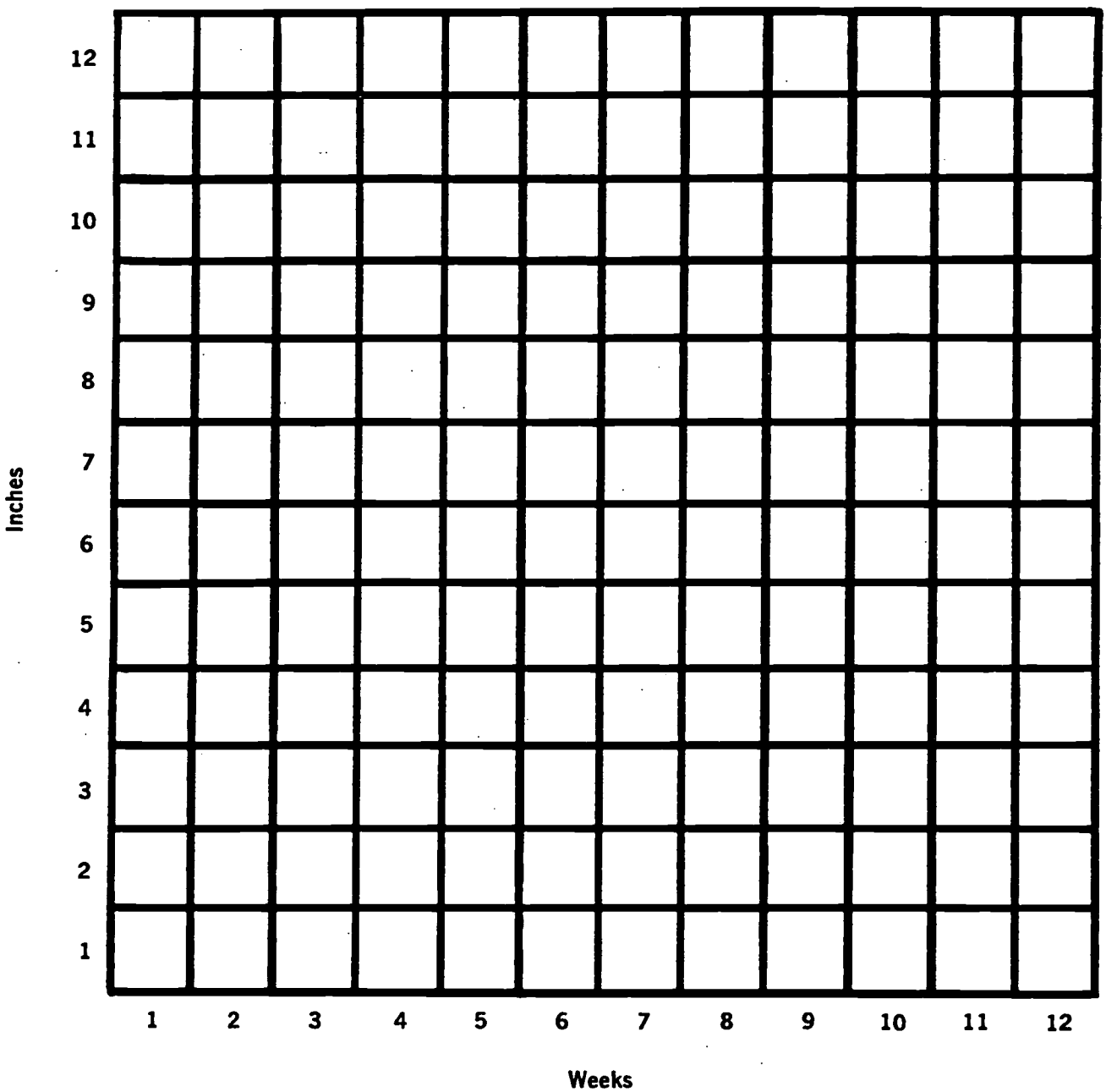
RED POTATOES	Sprouting Date	End First Week			End Second Week			End Third Week		
		Height	No. Sprouts	No. Leaves	Height	No. Sprouts	No. Leaves	Height	No. Sprouts	No. Leaves
Sunny										
Middle										
Shady										
WHITE POTATOES										
Sunny										
Middle										
Shady										

Graph the growth patterns as follows:

babyfood jar	----------
peanut butter jar	.....
2 lb. coffee can	xxxxx
3 lb. coffee can	ooooo
larger	+ + +

Name _____

CONTAINER SIZE AND MAXIMUM GROWTH OF POTATOES



Nature's Part In Art

An Environmental Investigation

BY
NATIONAL WILDLIFE FEDERATION
MINNESOTA ENVIRONMENTAL SCIENCES FOUNDATION, INC.

In an age where almost everything of "quality" is man-made and machine-crafted, people sometimes have misconceptions about nature. They think that it is fragile, useless or good only for gazing, smelling, touching and hearing. To the contrary, natural items comprise all that's necessary to fulfill man's needs--as thousands of generations have demonstrated.

We feel that it is important to make children aware of Nature as the Provider. **Nature's Part in Art** starts that process by portraying nature as the true art supply shop. The unit helps children see, feel and experience their environment, while collecting natural items for art projects. The main objective behind these activities is to give children intimate contact with their environment and to have them discover, first-hand, some of its many components.

INTRODUCTION

Children learn more,faster and more enthusiastically when they touch the real world than when they experience it only vicariously. The art activities in this unit were devised with this idea in mind. In every case an effort has been made to present a new or little known technique for displaying or using natural items as media. An effort has also been made to present art experiences that will be science experiences.

We have included several techniques for reproducing natural items by printing or casting. Unique displays are suggested for showing plant growth near a pond and making arrangements with driftwood, pebbles, and dried weeds. Sand painting and soil painting suggest the use of natural items as media. An artistically arranged mini-terrarium brings life to art, and a few activities are provided just for fun. All the activities should be enjoyable.

This unit is just a beginning. We hope you will try these ideas, expand them and enrich them to suit the class. The important thing is to get the children to appreciate nature and hopefully to become more concerned about it.

MATERIALS

basin or pail
drying rack
paint brushes
pots and pans
plexiglass
light source
tempera paints
charcoal
plastic bags
specimen containers
plaster of paris
straw (grain stalks)
nails
spoons
celluloid
plasticene spray
wallpaper sample book
assorted design and decorating books
hot plate
wool cloth or yarn
wax
clothes iron
heavy cardboard or wood
overhead projector
paint rollers
white glue
rubber bands
pins
liquid soap
coat hanger
lumber scraps
food coloring
scissors
heavy board
pictures or design, man-made items
sieve or muslin
cotton cloth
newspaper
blueprint paper
clothespins
assorted paper
printing ink
fiberboard
lacquer or shellac
paint containers
boxes
fine sand
paper clips
trowel
string
thread
baby food jars
paper plates
soil
large paper bags
print fabric samples

Nature's Part In Art

Plant Dyes

PLANT MATERIAL TO GATHER

PLANT	PLANT PART	COLOR PRODUCED
onions	brown outer skin	yellow
black walnuts	husks	brown/black
beets	beets	red
blueberries	berries	dark purple
red cabbage	cabbage	blue-violet
grapes	grape	pink
birch	leaves	yellow/beige
spinach	leaves	green
elderberries	berries	red
nettles	roots and leaves	yellow
bloodroot	roots	red
briar	root	violet
butternut	husks	purple
red cedar	bark, berries	khaki
mullein	leaves	yellow

Note: The activities in Part 1 and 2 involve the use of hotplates and boiling water. We have written the unit in terms of the children doing all the activities. However, if your students are very young, you will want to set up one hotplate at the front of the class and [redacted] dye the material as a class project. With older children, you might have several hotplates around a central area with groups of children working on different dyes. You will want to decide how best to do this, depending on the age of your students.

MATERIALS

plant material (see chart) a large pan of water
hotplate pail or basin sieve or muslin
drying rack wool cloth or yarn to dye

I. Dyeing Wool

Have the children boil a dye-producing plant part in water 10-15 minutes. They should use about 2 cups of water for every cup of plant material. Have them cool the water and strain out the plant parts.

Now have the students place the wool cloth or yarn in the cooled dye and bring it slowly to a boil, stirring gently. Remove the cloth and drain in a strainer when it reaches the correct color. (Note: Pieces of cotton sheeting work well for beginners. This is a much simpler and cheaper method but the results aren't as colorful.)

II. Making Batiks

In batiking, a hot melted wax is applied to cloth in some type of pattern or design. The cloth is then dyed and when the dye has set, the wax is removed. The dye will not penetrate those spots where the wax has been applied, producing a pattern or design.

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Have the children boil some of the dye-producing plant parts in water for 10-15 minutes. Use 2 cups water for 1 cup plant material. Cool and strain out the parts.

Next, they should melt wax (paraffin, beeswax, old candles) in a double boiler. The amount of wax needed will depend on the size of the cloth to be covered. The wax should be hot enough to soak through the piece of cloth when applied. The wax has to penetrate the cloth to keep the dye out.

Technique 1. Have the children take a white piece of cloth (old sheets are great) and with a paint brush, dribble wax on the cloth. Emphasize that where the wax is, the cloth will remain white. The wax must soak through the cloth. Then have them place the cloth in the lightest dye of all the colors they have chosen to use until the cloth is the desired shade. Remind them it will be lighter when dry. They should hang the cloth to dry out of the sunlight. When dry, have them dribble wax on parts they want to remain the first shade dyed, then have them put the cloth in the second lightest color. Hang to dry. Repeat this process until they have used the darkest color last.

When the dyeing and drying is complete, the cloth should be ironed between several sheets of newspaper to remove most of the wax. If some wax is left, the colors will remain brighter. Frame or hang the artwork any way the class wishes.

SUGGESTIONS: Pictures and geometric designs can be created by painting the wax on the cloth rather than dribbling it. Only small spaces can be waxed at time because the wax cools quickly. Both water and sunlight damage the dyed cloth, so avoid both. Try using other plants for dyes that haven't been mentioned here.

Technique 2. Have the students take small portions of the piece of sheet and wrap it securely with string or thread, overlapping the string many times to keep dye from the cloth. They should then dip the knotted pieces into the dye (making sure they use the lightest dye first). They should let the sheet dry and then retie it in other areas leaving the first areas tied. Then they should re-stain it, using a darker dye and again allow it to dry. If they wish they can retie and redye a third or fourth time. The colors will remain the color of the original cloth.

Printing

Several days before you plan to begin the classroom activities, have the children begin collecting a few flat natural items from their surroundings--leaves, twigs, weeds, etc.

I. Blueprints

MATERIALS

blueprint paper heavy cardboard or wood in different sizes
clothespins light source leaves, weeds, grains, branches
sheets of plexiglass (available from art supply or hardware store, in a variety of sizes, 4 to 5 sheets)

After the children have gathered their natural items, have them cut out pieces of blueprint paper. Each child's sheet of paper should be large enough so that all the items collected can be arranged on it.

Have the children cut pieces of cardboard the same size as the blueprint paper. Have them put the cardboard on their desks, then put the blueprint paper on top, with the blue side up. Then arrange the natural items on the paper. Then put a piece of plexiglass the same size as the paper on top of the items. Fasten with clip on clothespins around the edges. Now have them expose the arrangement to the light source (overhead projector, sun, etc.) Wait until most of the blue paper has lost its color. Then everything should be separated and the paper rinsed in cold water to fix it. The prints should be allowed to dry in a flat position. Then have them trim the prints for display.

II. Tempera or Printing Ink

MATERIALS

paper, 12x18, 9x12, white, manila, assorted colors
tempera paints or washable printing ink, assorted colors
paint rollers, 4 inches wide
containers--paper plates, to use as paint bins for rollers

On the day you plan to begin the activities, select a location in the room for each color that your students will use. These places will be the color **stations.** At each color station place one color of paint or ink, a roller and a container to hold the paint.

A. Applying Paint to Paper

When the students are ready to begin printing, have them each select one natural item which they want to print and a piece of paper to print on. Put the item on the paper, then put paint in the plates and dip a roller in the paint.

The children should now roll the paint lightly over the item, covering all sides. They should continue this until each is satisfied with the shade of color. The item should be lifted quickly to reveal a silhouette of the item. This procedure can be repeated on the same piece of paper using different colors, items and locations on the paper.

B. Applying Paint to Natural Items

Have the children either dip the item into or roll paint on it. They should place this item on the art paper and top it with another piece of paper. Have them press slowly and carefully over all the parts of the object so that all the paint will be picked up. When the paper and the natural item have been separated, two prints will have been made.

The print may be left as is, or variations might be added by using several natural items, colors and arrangements for a different composition.

III. Pattern Printing

MATERIALS

paper ink or paint brush or roller pan for paint
natural items with distinct texture that will print

Have the students place paint or ink on the natural item by either dipping it or painting it. Then have them place the item on sheets of paper. If the surface of the item is flat, they can press it down to get an imprint. Others can be rolled across the paper for a repeating pattern. Encourage experimenting with colors and objects to make scenes.

IV. Shadow Tracing

MATERIALS

paper-large roll and smaller sheets, according to the size of the item to be traced
light source leafless twig or branch stones
black crayon or charcoal

Select a sunny, windless day; break the class into teams of two, and have each find a leafless twig or small branch. Then give each team some paper. Have them hold the paper on the ground with stones, then one child holds the branch above the paper so the shadow falls on the paper. The first child can trace the shadow with crayon or charcoal. Then have them move the branch to form a different shadow and trace again. Continue as long as they want retracing the shadow in a variety of positions.

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Displaying Natural Materials

A. Collage

MATERIALS

fiberboard (one large sheet or several small pieces)
applicator--brush, paste spreader, piece of wood
paste--1/2 white glue and 1/2 lacquer
natural materials for large display--rocks, leaves, grasses, seeds, etc.

This next activity can be done as a class project using a large piece of fiberboard or as an individual or team project using smaller pieces of board. The aim if for children to gather some natural objects which they find either around their home or on their way to school, or during an organized class field trip. They then glue these to fiberboard to make collages.

Ideally, it would be best to let the children collect just what they want without suggestion. If done as a class activity, you may have to give them some guidelines. If using a park area, restrict the collection to fallen leaves, dead branches, small stones, etc. Be sure to have permission before collecting anywhere other than your backyards.

Prior to collecting, show the class the piece of board so they have an idea how large the display will be. After they have collected their items, allow them time to plan their arrangements without using glue, on their desks or tables.

When this pre-arranging has been completed, have the children cover the board with the paste mix, then press their natural items on it until firm. Allow this to dry for 24 hours before hanging it up.

B. Cross-Section of a Pond's Edge

In this activity, the students will reconstruct a cross section of a pond edge by gathering natural materials at various intervals leading away from the pond, on a line roughly perpendicular to the pond edge.

MATERIALS

fiberboard (a 4x8 sheet) **paste (1/2 glue 1/2 lacquer)**
applicator **natural materials**

Take the class to a pond and have the students observe the vegetation in the following areas:

in the water at the edge, growing in water
at the edge, growing on land 1/2 foot from water
1 foot from water 2 feet from water
3 feet from water 4 feet from water, and so on

Have the class choose an interesting spot which extends back several feet from the ponds edge. Then have the class collect vegetation samples from all eight areas listed above as well as at other distances you choose. The collecting should be done along a single line which is straight out from the edge. Have each team label their collection according to the distance out they found them.

When back in the classroom, place the fiberboard on a flat surface. Explain to the class they are going to create a cross-section of the pond by placing their items in the order they found them on the board, from one edge to the other. For example, you would start with sand or gravel, rocks, short grass, tall grass, etc. Begin making the model by spreading the paste mix on the board completely. Start with the water area first by placing duck weed, pond materials and water plants on the board, pushing the items in the paste, and holding them until firm. Continue inland from the pond edge by placing and holding the other items in the paste. Let it dry for 24 hours.

C. Imaginative Creatures

MATERIALS

white glue	natural materials in interesting or unusual forms; rocks, twigs, roots, etc.

The collecting will have to be done by the class over a period of time to make sure they collect enough unusual forms. When each child has collected what he wishes to use, have them decide how he will put them together to make an unusual creature. They could make one large creature as a class, or several smaller ones. They should consider combinations of the materials for the best effect. Driftwood or rock could serve as a base for the creature, while roots and gnarled branches would make interesting bodies. Glue the base and figure together. Use moss, twigs, seeds, weeds, small pebbles, etc. to add features to the creatures. When finished, the students could write poems or tell stories about their creation.

D. Centerpiece of Decorative Structure

MATERIALS

white glue	natural items: twigs, roots, acorns, rocks pinecones, berries, grains and grasses

The collecting of natural items on the materials list will have to be done over a period of time, done independently by the students. Have them look at all the items they've collected, and decide if they want to make one large centerpiece or several small ones.

Have them glue the items together, holding them in place until they are set. Suggest they will want the arrangements simple, and not to include too many of the natural items.

E. Terrariums

MATERIALS

containers; clear plastic box or glass jars, for each student
plastic wrap or bags
rubber bands or string
natural items-as in previous activities

Carry all the materials for holding and covering the terrariums out to the area where the students will be collecting the natural items. It will be better to have each student create his own small terrarium than to have the class as a whole make larger ones. You could have one large class terrarium and individual ones.

Make sure each child has his own container. Ask each child to put in his jar: soil, small plants, dried plants, rotting wood, acorn or gall. Have each student cover a container with one layer of plastic wrap, with a small pencil hole in it for air and water. Once back in the class, have each person add a few drops of water to their containers. Condensation on the inside walls or cover will indicate there is enough water in the terrarium.

Sand Casting

MATERIALS

boxes-wooden or cardboard
fine sand
shellac
plaster of paris
liquid soap
trowel
an item to print: animal track in hard soil (dried mud works well for this) or an animal foot
paper clips

Have the class search for tracks outside, in dirt near water. Areas that have been wet and then dried work best, but the track should be in the driest or hardest part of the dirt to make a cast. If time or weather is a problem, you could dig around the track, removing it to a box and take it back to the class. At the sight or in the class, the print should be shellacked and allowed to dry.

After drying, have the students fill in the box around their prints with fine sand, until it is level with the edge of the soil containing the print. Then have them coat the prints with liquid soap.

Next, have the groups mix plaster of paris and pour over the prints to 1" thick. A paper clip should be imbedded in the mix to aid in easy removal when dry later. Once the plaster has dried, the children can remove them from the dirt and brush them off. They can paint them or use them to make other prints.

Structures

A. Grain Stalks or Straw

MATERIALS

straws-several large ones per student pins
glue base materials-wood, paper and tray

Have the children make an interesting structure out of natural straw they have gathered in a field. They can cut the straw in any length, several inches long. Pieces of straw can then be glued together to make some basic geometric shapes such as a triangle or square. This can be done on waxed paper, using pins to hold the straw in place until the glue has dried. These individual sections can be glued to make a three-dimensional structure. Each structure can be placed on a wooden or paper base if a student wishes. After the structures are complete, some students may want to test the strength of theirs by cutting a straw here and there to see how long it will stand.

B. Mobiles

MATERIALS

rigid wire, or coat hangers string thread
natural materials--bark, twigs, grains, leaves, seeds, weeds, branches

The mobiles could be made by individuals or by small groups of two or three students each.

Have the students lay out the materials on the floor or table, and begin to place them in the order they want them to hang from the ceiling. The best way to make a mobile is to start with the bottom objects. Tie string around the object, and then to the wire (rubber cement helps attach the knots securely to the wire) on the ends of the wire. Next, tie another piece of string to the middle of the wire, so that it balances with the bottom objects; glue the string to the wire. Then on another piece of wire, attach an object to one end of it. They should then attach that system to the first wire holding the bottom objects. Balance the second wire to the first wire, attaching the string with rubber cement. Finally, attach objects to a third wire, and balance the middle one from it with string and glue. They can make as many layers as they like, but for very young children, it is best to use three. By starting at the bottom and balancing them as they go upward, the entire mobile will be balance when it is finished.

One of the interesting thing the children will probably discover while building these, is that a heavy object placed a short distance from the string which supports the wire can be balanced by a much lighter object placed at a greater distance from the string.

This is but one way to construct a simple mobile. The class could experiment with other arrangements.

Sand Painting

MATERIALS

fine sand babyfood jars spoons food coloring
white glue brushes container for glue mix
paper plates paper--soft colors, white

1. Preparation

A. Coloring Sand

Have the children fill the baby food jars about half full with sand. Then have them put in several drops of food coloring and stir. Then they should check the sand to make sure it is the color they want, adding more color if wanted. Then they should shake the sand out onto a tray or a piece of paper and allow it to dry overnight.

B. Preparing the Glue

Have the children fill several jars or glasses about half way with white glue, and half with water, then stir. Keep some glue in the original container undiluted.

2. Painting a Simple Design

On sheets of paper have the children plan the colors and designs they will use in the different areas. Then have each child paint on the glue mix in a pattern where he wants one color. Then the sand of that color should be sprinkled on the glue and the excess shaken in the container. Let the glue dry.

Next, have the children brush the glue on the paper for another color of sand, and sprinkle it on that area. Continue until the designs are finished.

3. Painting a Raised Design

Again, on paper, have the children plan their designs and colors. Then using the original glue bottle, have then\m squeeze a thick line where they wish to have one color. Next, they should sprinkle on the sand of the chosen color and shake off the excess. The children should then squeeze another lime where they want another color, sprinkle on the sand and shake off excess. Have them continue until all the colors in the design are used.

4. Painting a Scene

Have the children draw a scene in pencil on a piece of paper and paint the glue solution over the entire picture. They should then carefully sprinkle the colored sand in the areas desired for background. After the first layer of glue has dried, add as many layers of color as desired by brushing the glue solution directly onto the sand wherever the additional color is wanted. Let each layer dry before adding the next.

When the picture is completed, it should be allowed to dry thoroughly. For the foreground items, glue should be squeezed directly from the tube a sand should be sprinkled directly on in several layers. The excess sand should be shaken off regularly.

Soil Painting

MATERIALS

soils and sands in different colors plastic baggies
white glue container for glue mixture small brushes
plasticene spray wood or cardboard

A. Preparation

Have the children gather soil from their yards, river beds, ponds, road cuts, etc., looking for the different colors in the soils.

To prepare the glue, mix in a jar half glue and half water.

B. Painting

Give each child a piece of cardboard or wood. On these pieces of material, have them sketch a scene, design or picture. Then have each child use a paint brush to stroke on the glue solution where he wants a certain type of soil. Leave the soil on the glue until dry. Repeat in another of the picture. If you want sharp color contrasts, let the glue dry in one area before applying in another. Continue this until their scenes are complete. Then shake off excess soils.

C. Preserving

When the soil and glue are dry, stand them on edge so loose soils fall off. They should repair any areas that need it. The pictures will be easier to keep of dust if they area sprayed with sealer or plastic when finished. After the pictures are completed, the children can frame them if they wish.

Dried Plant Arrangements

MATERIALS

white glue small containers dried plant matter paint brushes plexiglass

Give each child a small piece of plexiglass--a dealer might have some scraps available. In a small container, have each child mix one part glue with four parts water.

The glue mix should then be painted on one side of the plexiglass. While wet, have the children put some of the dried plant matter in the glue. Have the children set the glued arrangement aside to dry. When it has dried, have the children add another coat of glue, covering both the plexiglass and the dried plants.

After the second coat of glue has dried, some of the children might want to put tape around the edges of their plexiglass to serve as a frame. Large pieces may be used as pictures; small arrangements may be used as pendants against a window, similar to a stained-glass look.

Another option is using celluloid and making dried plant 'sandwiches'.

Have the children arrange dried plant parts in a pattern that they want to keep. Give each child two pieces of celluloid, or one large piece to cut in half, or fold over.

Mix one part glue to four of water in small containers. Paint one side of the two celluloid sheets. Place the dried plants on one side and cover with the other piece. Put heavy objects on top to press them down. The size of the celluloid could determine the use of the finished product; bookmarks, placemats, pictures, etc.

Stone Structures

Children enjoy collecting small stones. These collections can be used to make sculptures by having the children glue the stone together. These designs can be abstract or realistic. The children might construct imaginative animals or real ones using other natural objects for features such as ears, eyes, mouth, legs. Paint can be used for these details, too. White glue works best for sticking stones together, but other adhesives work also. Spray the finished creatures with plastic sealer or an acrylic clear coat.

Litter

Plan to have the children bring in objects they find around the school yard, near home or on field trip. Sort these out to choose which ones will be on the structure. Use a large branch for the base, and use the litter items to decorate the tree by hanging them from string or wire. Put the base in a bucket or pail filled with rocks or sand. Put the heavy items at the bottom and the lighter ones on top. Display in the school where all the students can see what was found. Write stories about how bad it is to litter, etc.

Man's Use of Natural Items in Design

Initiate this activity by bringing in a wallpaper sample book. Have the class look at the patterns and see if they can pick out the many ways

the designer used familiar natural items in his design. Can they see real or abstract leaves? Animals? Trees? Anything else?

Then have each child design his own wallpaper using images of things from nature. Ask the class to bring in a piece of fabric or clothing with a print displaying items of nature. Have each child design a fabric print using natural images.

Many man-made objects incorporate patterns from nature in their designs. Ask the children to look at silverware and dishes at home and notice whether the patterns are borrowed from nature. In class, the children can try designing their own patterns for use on serving pieces and dishes.

In all of the activities involving natural design, you will find it helpful to have a variety of resource books available for the children to use as reference. You may want the class to collect in a notebook samples of nature used in designs as well as the designs that they have devised, You might point out to them that almost all pleasing designs are representations or abstractions of natural objects, or of configurations which are found in nature.

Ozone Activity

An Air Investigation

BY
OREGON STATE UNIVERSITY SEA GRANT COLLEGE PROGRAM
OREGON DEPARTMENT OF EDUCATION

The educational concept of this unit will show students that shorter wavelengths of light such as ultraviolet can harm living organisms, and that the **ozone layer** protects living things from dangerous doses of ultraviolet radiation. Students can demonstrate the destructive properties of UV light and demonstrate protection from the ozone in the stratosphere.

Ozone Activity

MATERIALS

triangular prisms grow light black light
sheet of plexiglass month-old bean and corn plants
black sheet of plastic

This activity can be spread over several days. Begin by growing plants in the classroom. The plants should be sprouted a month before you plan to conduct the activity.

Inform yourself about safety practices with black light. Use the black plastic to shroud the experiment to shield the class from UV light.

Explain that there are ways to break sunlight into different wavelengths. Ask students if they know of ways that light rays can be broken up.

Divide the class into cooperative lab groups. Pass out a triangular prism to each group. Using the light beam from a slide or film projector, demonstrate how light can be separated into different wavelengths. If there is sufficient sunlight, have students use the prisms outside and experiment with separating white light. Explain the different colors of light in the spectrum represent different wavelengths of light on both ends of the spectrum that we can not see. Explain that the shorter wavelengths of light are called ultraviolet and we cannot see that light. The lengths that are longer than red are also invisible and are infrared.

Introduce ultraviolet light and show students the black light. Explain that this light gives off ultraviolet rays we can not see. Use appropriate safety precautions when using this light.

Set up three plant stations. Each station should have 2 - 3 plants. Explain to students that they are going to test to see if different kinds of light affect how plants grow. Ask each lab group to make predictions about the experiment.

Time	Station 1 Grow Light	Station 2 Black Light	Station 3 Black Light with plexiglass between light and plastic
10 min	_____	_____	_____
1 hour	_____	_____	_____
Day 2	_____	_____	_____
Day 3	_____	_____	_____

Each group should have their own chart and then transfer results to large butcher paper. Discuss observations. There should be an observable difference between plants grown under the black light and the grow light. The plexiglass should protect plants from UV light.

Show the class illustrations of the stratosphere depicting strato, troposphere and the ozone layer. Share information with class about the role of ozone and how it protects Earth from the UV light. Relate the plexiglass to the ozone layer.

After they have been given information about the ozone layer, access how students apply their observations about the bean plant experiment to the ozone layer.

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The Predation Game

Water Environments Support Life

BY
OREGON STATE UNIVERSITY SEA GRANT COLLEGE PROGRAM
OREGON DEPARTMENT OF EDUCATION

In this activity, students will graphically learn principles of predation and predator-prey relationships by becoming predators themselves. They will explore the population dynamics of an artificial population of animals in a controlled setting. Students will understand how marking a portion of the population can lead to an estimate of the whole population.

The Predation Game

MATERIALS

caramel candies, 2 flavors graph paper pencils
masking tape for marking 'prey'

Allow about 45 minutes for this activity. It can be conducted in the classroom or outside, even in a park or natural area. Pick the area beforehand. Ideally, it should have an open space in the middle with a good deal of edge habitat available. Distribute the caramel candy (animals) just prior to the activity -- 20 to 25 for a group of 10 - 13 students. Do not hide the candy too well; put some in the open, while others are hidden.

Begin by asking the class what a predator is and how it obtains food. Brainstorm some examples. In the ocean environment, kids may think of seals, sharks and sea birds as being predators. Explain to them that they are going to become predators by hunting down and eating a small animal that lives in this area. Describe the prey as completely as possible without telling them what it is (candy).

> Example: it's about 1" long, females are light brown, males dark brown; VERY slow moving and like the area you have chosen for the activity. It dislikes full sun, dies upon being touched and has a very thin skin.

When you gather your group near the area, explain that the activity is going to be a game; that each have one minute to find a prey animal. If they don't find one in that time, they will die of starvation and drop out of the game. If you want to deal with the sex ratios of wildlife populations, have them yell out 'male' or 'female' as they find them and keep a tally. Use the chart below:

	MALE	FEMALE
30 sec		
1 min		
1 1/2 min		
2 min		
3 min		

Ask for questions and them let them go on the hunt. When the last predator has died, usually about 5 minutes, gather them together in a circle to discuss what happened.

You might want to graph the results of the tally, which could look like the chart below, or something similar. Use the graph for discussion about uneven sex ratios, search strategies and images, food chains and webs, food and energy pyramids, etc. The discussion could lead almost anywhere so have fun and let them explore the possibilities.

If you are with older kids, you may want to mark some of the prey before hiding them. Put small pieces of tape on half. When the game is over, make an estimate of the total population by using the following ratio:

$$\frac{\text{Total 'Marked' Found}}{\text{Total Found (Marked and Not)}} = \frac{\text{Total Number 'Marked'}}{\text{Total Population Est.}}$$

For example: $\frac{5}{12} = \frac{10}{X}$

By solving for crossproducts, we get the estimate:

$$X = 24$$

Do this several times, varying the total number marked each time.

There's Too Many Of Us!

A Population Study

BY
OREGON STATE UNIVERSITY SEA GRANT PROGRAM
OREGON DEPARTMENT OF EDUCATION

This unit deals with the study of populations and graphing the growths of certain groups. It reinforces the concept of people needing water, and water environments supporting life.

Students will understand how population growth can affect water, air and land resources. Allow about one class period for this activity, and it can be conducted either in the class or outside in a park or natural area. The only materials required are paper and pencils, and copies of the following problems.

This unit can incorporate math, social studies and sciences. Students calculate the problems to estimate population growth in four different situations. Draw conclusions and compare to accompanying population growth chart for various countries.

Discuss the following situation with students then have them calculate the following problems:

Country A is a poor country. There is little educational opportunities. Most of the country is rural and the people depend on farming for their livelihood. At the beginning of this exercise the country is self-sufficient. It can produce enough food and energy for its population.

In Country A, family planning information is limited and, consequently, the average family size is eight children per couple.

Begin the activity with three couples. Add eight children for each couple and remove 50% of the population to represent those who die. Run your activity on a 3-year cycle. At the conclusion of 30 years, calculate the population of Country A.

Population Country A: Average family size 8 children per couple.

6	3 couples x 8 children = 24
+24	
30	30 x 50% = 15
-15	
15	POPULATION AT THE END OF FIRST 30 YEARS

15	7 couples x 8 children = 56 children
+56	
71	71 x 50% = 35
-35	
36	POPULATION AT THE END OF SECOND 30 YEARS

36	18 couples x 8 children = 144
+144	
180	180 x 50% = 90
-90	
90	POPULATION AT THE END OF 90 YEARS

90	45 couples x 5 = 160
+160	
250	250 x 50% = 125
-125	
125	POPULATION AT END OF 120 YEARS

COUNTRY B

Country B is a rich well-developed country. Education is available to all and a high standard of living is enjoyed by most of the population. The average family size is three children.

Beginning again with three couples, follow this population through 120 years. Calculate the population size at the end of each thirty-year cycle. Use the 50% death rate for this population.

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6	3 couples x 3 children per couple = 9
+ 9	
15	15 x 50% = 7.5 or 8 deceased
- 8	
7	POPULATION OF 7 AT END OF FIRST 30 YEARS

COUNTRY C

Country C is a developed country but does not have a high standard of living. Housing is scarce and families must share housing with other members. Family planning is readily available. The average family size is one child per couple.

Begin calculation of population growth as with the other countries. Use 50% for deceased rate. Calculate population size at the end of the 120 years.

6	3 couples x 1 child per couple = 3
+ 3	
9	9 x 50% = 5
- 5	
4	POPULATION AT THE END OF THE FIRST 30 YEARS IS 4

DISCUSSION QUESTIONS

1. How long did it take Country A and B to double their populations?

2. Discuss with students or have them write a short essay on the effects of the population of Country A on water resources, soil, and other natural resources. Discuss the consequences of such rapid population growth in Country A.

3. If a country wished to reduce its population, what average family size must it encourage?

4. Compare the population growth of Country A, B, and C with the actual data listed on the chart. What countries match Country A and B? Is there a country that matches Country C?

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EUROPE

COUNTRY	YEARS TO DOUBLE POPULATION	ESTIMATED POPULATION BY 2000
Austria	3,465	7.4 million
Belgium	495	9.9 million
France	151	56.7 million
Norway	239	4.1 million
Sweden	3,465	8.0 million

NORTH AMERICA

COUNTRY	YEARS TO DOUBLE POPULATION	ESTIMATED POPULATION BY 2000
United States	95	268.0 million
Canada	85	33.8 million
Mexico	27	115.0 million

SOUTH AMERICA

COUNTRY	YEARS TO DOUBLE POPULATION	ESTIMATED POPULATION BY 2000
Peru	26	30.7 million
Columbia	35	38.2 million
Brazil	30	187.0 million
Ecuador	22	14.6 million

Source: 1983 World Population Data Sheet of the Population Reference Bureau

Of 176 nations listed on the World Population Data Sheet, 103 had population doubling times of 20 - 30 years. Sixteen nations had 100 years doubling time and only two were listed as having doubling times of 3,000 years.

For other population teaching materials contact:

Population Reference Bureau
1337 Connecticut Avenue NW
Washington, D.C.

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WORLD POPULATION GROWTH: A SHORT OVERVIEW

Historically unprecedented population growth in developing countries has profound implications for U.S. foreign policy.

Even with a continuing slowdown in the growth rate, world population is likely to increase from the current 4.5 billion to over 6 billion by the year 2000....a growth in only two decades the size of which is nearly equal to the the entire world population just fifty years ago.

Some 90 percent of this growth will occur in low-income countries. The proportion of industrialized countries' population in the world total, which was one-third in 1950, and about one-fourth now, is likely to decline to only one-fifth by 2000. The number of young adults (ages 20-39) will increase in the North by 17 million between 1980 and 2000...in the South by 600 million.

These changes will obviously affect economic development prospects, exacerbating problems of malnutrition, overcrowded cities, unemployment, deforestation, and water supply. They will also bring increased dangers and potential for political instability, social unrest, urban crime, and emigration. Among areas most affected by rapid population growth are Latin America, Egypt, Nigeria, Kenya, Indonesia, the Philippines, India and Pakistan.

If the world's population should eventually stabilize in the next century at 10.5 billion, a relatively optimistic projection, the industrialized countries would then account for only about one-eighth of this total (with North America at 3 percent). Fastest growth seems likely in Africa (from 470 million at present to over 2 billion...or 20 percent of the world's total) and Latin America from 360 million to 1.2 billion...12 percent of the total).

While the situation is serious, it is not hopeless. Demographers estimate that a doubling of family planning practice in the Developing World by the end of this decade could mean half a billion fewer people by the year 2000, or an eventual possible global stabilization (in the next century) of 8 billion.

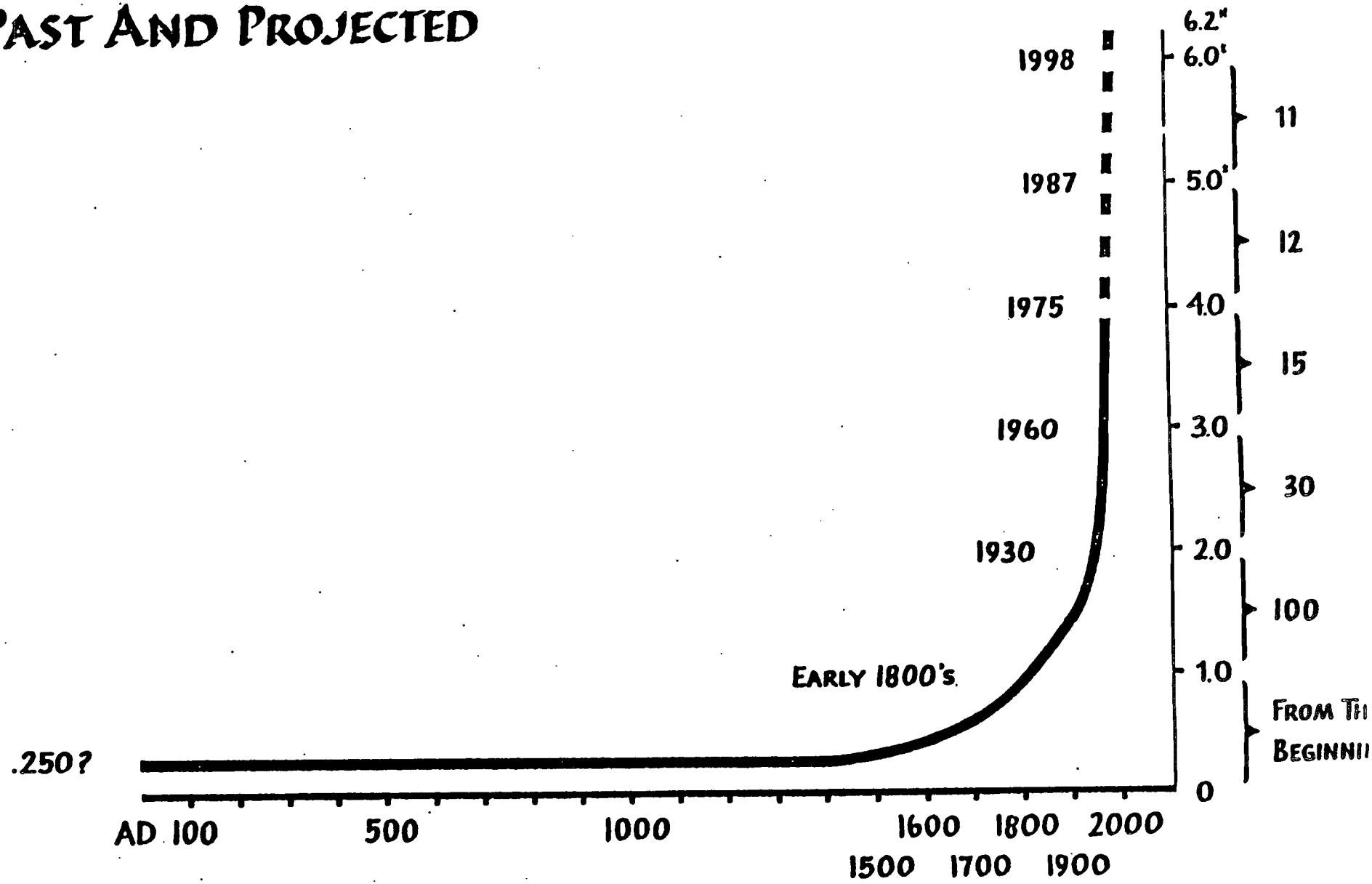
Population is not a North-South confrontational issue. Many Developing World leaders have spoken out on the need to reduce fertility in order to achieve economic growth on both a national and personal level. This theme is also supported by the UN International Development Strategy for the 1980's, the Ottawa Summit Declaration, and Asian and African Parliamentarians Conferences in 1981. China, Singapore, Indonesia, Thailand, Korea, Tunisia, Columbia, and Mexico are among countries which have demonstrated that concerted policies can bring down birth rates.

Further fertility reduction in most countries will, however, require considerably greater efforts in motivation and expansion of family planning services. AID and the UN have significantly more requests for help than they can handle on current budgets. Additional funds are also needed for research in development of safer and better methods of family planning.

Failure to intensify international and national efforts, on an urgent basis, risks undercutting of development and security assistance. Consistent with our traditional concern for human dignity and the quality of life, the U.S. should continue its leadership role in providing assistance for voluntary family planning programs.

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The World's Population Growth: Past And Projected



* U.N. Medium Projection Variant



CLASSROOM AND SITE ACTIVITIES GR. 7-12

Change in a Small Ecosystem

An Environmental Investigation

BY
NATIONAL WILDLIFE FEDERATION
MINNESOTA ENVIRONMENTAL SCIENCES FOUNDATION, INC.

The natural and the human worlds are divided into relatively distinct units called communities. All communities have features which set them apart from each other. It is easy, for instance, to distinguish between a prairie and a forest, a pond and a stream. But communities are rarely stable entities. With time, they undergo a variety of changes and sometimes transform into completely different units. At times, even short-term changes--day to night, seasonal, etc.--can be detected.

A patterned sequence of change in a community is called succession. In a sense, the development of a village into a town into a city into a big city is similar to succession in a natural community. Ordinarily, growth in a population center like a village or town is a self-perpetuating process. The same is true of natural communities. For example, certain patterns of events occur which cause a pond to become a marsh. In time, the marsh may be transformed into a prairie or forest.

As the features of a community undergo change, so do its members. A pond may have once contained a sizeable number of fish, but as it is transformed into a marsh, the kinds of fish it can support will change. Eventually all fish will disappear and new life forms will appear in the marsh. Deer may now rest in or near it instead of being only transient visitors.

This unit is about communities and succession. The implications of the unit can be far-reaching. We hope the activities provided will help your students grasp the concept of succession and that gaining this understanding will, in turn, help them appreciate how change affects all environmental neighbors.

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INTRODUCTION

Studies of succession are usually carried on over periods of years because community change is a slow process. However, **Change in a Small Ecosystem** describes a method for investigating community changes which may occur in a short period of time. The unit has the class consider changes in small aquariums created from water samples of a nearby water source. In this case, the aquariums are actually jars of quart size and smaller.

In the unit, students will collect and periodically examine water samples. Over a period of time there will be changes in the numbers and types of organisms in the water. Exactly what will happen cannot be predicted because it will depend upon the contents of the original source of water and upon conditions in the aquarium. In general, though, certain organisms may at first be abundant and then appear to die off. A different type of organism may become evident in large numbers only to disappear in time. The children may also observe that one or more organisms are always present in large numbers while others seem to disappear and reappear every so often. There is no guarantee, of course, that what happens in one micro-aquarium will happen in another.

The activity which children observe in their small aquariums will be representative of activity which would take place in the larger body of water from which their samples were drawn. But conditions in an aquarium are not the same as those in a pond, stream, or water-filled ditch. As changes occur in the aquariums, you will want to caution the children against drawing exact parallels between their micro-communities and the natural community.

Although specific events and relationships are unpredictable, the general pattern of events will not be haphazard. Through observation and discussion, the children should come to realize that a kind of pattern does exist among the various events occurring in the aquariums. While the activities of this unit are primarily directed toward investigating those particular events, the materials should lend themselves to a wide variety of related investigations. In the back of this unit there are some suggestions for furtner activities.

MATERIALS

quart jars & lids--mayonnaise, peanut butter, etc., smaller jars with lids
water
microscopes
hand lens--10x & 15x type
microscope slides and cover slips
methyl cellulose (optional)
soda straws
cotton
plastic bucket
plastic bags
thermometers
brewer's yeast or flakes of uncooked cereal
rubber bands

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Change in a Small Ecosystem

Pre-Field Trip

Before the students begin the field trip you might want to select and investigate a nearby source of water. Check for small but visible living material in the water. A pond, water-filled ditch, a marsh or a swamp area are all excellent sources of water rich in microorganisms. Estimate the time needed to get to the area and back so that you may plan your field trip schedule. In selecting the site also consider its accessibilty for the children, the depth of the water source and the ownership of the property.

Several days before the field trip, ask each child to bring to class a container which could be used as an aquarium. Peanut butter, mayonnaise, or babyfood jars are all suitable for use as small individual aquariums. Each jar should be labeled with its owner's name and set aside for the time being. You will also want to have jar lids or other covering material available to use later on to prevent evaporation. Make sure you have all the equipment you will need (see Materials list on previous page) so that the children may begin their observations immediately when they return from the field. Before going to the field site, you will also want to duplicate the water sample collection card in the back of the book and hand out a copy to each student.

Field Trip

MATERIALS

plastic bags
rubber bands
nets
buckets
thermometer

The students should wear clothing appropriate for the field: old shoes, jackets, boots, etc. Discuss what special safety precautions will be necessary if the water is deep.

Each student should be given a plastic bag, a rubber band, and a water sample collection card. Additional materials such as thermometers, nets and buckets may be distributed among the students so they can help carry these to the field site.

When the students reach the site, remind them to be careful while they are collecting samples. If the body of water is large enough, students should each select a site along the bank or shore which offers easy access to the water and where there is no danger of their falling in. Plastic bags should be dipped into the water and half filled. Each student can also collect a small handful of debris such as mud, leaves, and sticks and place it in his water sample. (Many organisms cling to such debris, so collecting it will provide a rich sample of various organisms. The nets should be handy for collecting the debris.)

Have each student take the temperature of the water at the spot where he has taken his water sample. As the students take the temperatures, have them record the readings on their collection cards. At this time, you will also want to have them take an air temperature reading for their cards. They should also take note of other characteristics of the pond or stream which they will want to include in their descriptive data.

When each student has taken a sample, have him close his bag with a rubber band. Then he should take a few minutes to complete his collection card describing the site, weather, and so forth. If time permits, you will probably want the students to return to the classroom immediately in order to begin examining the water.

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WATER SAMPLE COLLECTION CARD

Student Name Susan S.

Date of collection April 9

Collection Site Description Small creek at Grant-Kohrs Ranch; trees, rocks, shallow water; sample from edge

Weather sunny, temp. 55°F. breeze from south

Condition of Water clear, some leaves + sticks, temp. 40°F. no smell

Classroom Activities

MATERIALS
jars
labels
hand lenses
paper

A. Preliminary Observations

As soon as the students return to the classroom, have them transfer their samples to their jars. (Make sure all the jars have been labeled with the names of the owners.) The students should have the opportunity to make general examinations of their samples. Distribute hand lenses and paper to each student. Suggest that they draw or describe in words some of the things they see. Some students may become so involved in observing that they will not, at this time, want to stop and make records. If such an assignment seems to interfere with their natural inclinations to "just look," it would be best not to press them. Eventually you will want them to collect their observations in a notebook for reference purposes, but if they appear to be enjoying the act of observing, they could start their notebooks the next day.

The students may expect you to be able to identify everything they see. Very few biologists, however, know the names or can recognize all of the organisms in a sample of pond water, so don't feel badly if you can't do that either. (The bibliography in the back of the book will give some help if you wish to follow up the identification.) Make it clear to the student who questions you that a name does not change the organism, nor does it make the organism any more understandable or any easier to observe. In fact, a name rarely has anything to do with what is important and unique about an organism. The students may want to make up temporary, descriptive names for some of the things seen in their aquariums. If they do decide to assign names, you will want to point out the need to be consistent. They must always use the agreed upon name when referring to a given organism. You will also want to remind the students that these names are for their current study only and that the organisms have other names generally agreed upon by the scientific community. For the interested students, you may make available some of the reference materials listed in the bibliography.

When the students have completed their initial observations, they should cap their aquariums loosely or place pieces of construction paper over the jars to prevent evaporation. When the materials are put away, encourage the students to share their observations with one another. They might enjoy describing what they saw or perhaps they could draw some of the organisms on the board for others to see. Eventually the students must cone to a point of agreement among themselves about what they see.

This means that each student must be aable to recognize an organism as being of the same type that other class members have seen.

B. Continued Observation

At this point you might want to have the students inspect their samples under microscopes as well as with hand lenses. Parts of several days should be spent in casual observations of the water. During this time the students will become familiar with their samples, will begin to recognize organisms they have seen before, and will accustom themselves to the use of the microscope and magnifying glass as observation aids. Encourage them to make large drawings of what they see, especially of the forms which they find commonly from day to day.

Proper use of the microscope should become a class goal during this period. Your own familiarity with a microscope will be helpful to those who cannot seem to get the "knack" of it. It would be a good idea for you to spend some time making your own observations in order to anticipate problems the students might encounter with the microscopes.

Often students have difficulty distinguishing between air bubbles, scratches on a slide or cover slip, and living organisms. Remind them that few living organisms are perfectly round (as opposed to air bubbles) or perfectly straight (as with some scratches).

Learning to use microscopes involves caring for them properly. Students should clean them before and after use, learn to carry them properly, and should not abuse them.

In addition to learning the use of the microscope for purposes of observation, the students should be introduced to some other useful techniques. In surveying the water for smaller organisms, special methods must be used to slow down the movement of the organisms. Methyl cellulose is a chemical which retards motion. If one drop of this solution and one drop of the water to be observed are put together on a slide, the desired slowing effect will be achieved. If meythl cellulose is not available, threads plucked from cotton and applied to a slide are also effective in trapping some of the larger microorganisms. Have the students experiment to find the amount of cotton required.

Students should recognize that examinations of the water are most easily made when the quantity used is no more than a single drop. Soda straws are excellent sampling devices for this purpose. Students should practice (with tap water) obtaining a single drop from a straw partly into the water and then putting one finger over the open end of the straw before lifting the straw from the water. For some students, cutting a straw in half makes it a more manageable device.

In this unit, mention has been made briefly of having the students make drawings and note descriptions of the things they discover in their aquariums. Often however, these kinds of activities can become the focus of attention rather than aids to investigation. The students should understand that records are kept simply because one can't always recall everything. Records are reminders; they are writtin evidence of observations and they provide students with source material for visual communication with one another. Therfore, it would be helpful to begin the development of a "gallery" of organisms--pictures of the forms seem by the students. As these are produced, they may be posted on the bulletin board and used as references during class discussion. In the back of the book there are sketches of some of the more common organisms which students might find in their samples. You might want to check these for reference.

Maintaining notebooks on a day to day basis will help students keep track of those events occurring in their cultures which can't be drawn easily. Color, odor and turbidity (cloudy, clear) are changes in water which the students should note daily. Eventually, written record should be standardized so that each student will collect the same kind of information.

Much of the students' observation may be done without your direct help. The excitement of exploration and discovery should keep the

students interested for at least a week. You may expect a great deal of casual sharing of observations and discoveries--most students want others to see what they have found. Encourage them to share their findings with others and you.

Planned Investigation

MATERIALS
rice
brewer's yeast
cereal

A. Predictions

After several days or a week of casual obsevation, some of the students will ask what to do with the pond water. A few might suggest some experiments. Others will want to feed the organisms. When you feel most of the class is ready to become involved in more directed study, it will be time to introduce them to several procedures for investigating the change or succession what takes place in their aquariums.

Experiments can be inconclusive if they are not conducted in a systematic way. On the other hand, experiments suggested and controlled by you may prove to be unexciting to the student whose interests lie elsewhere. Your role, then will be to exert only that degree of control required to get results--but not too much to interfere with the natural interests of the students.

One way to maintain interset would be to encourage the students to conduct experiments of their own choosing while they are involved in the succession study. In additon, have them discuss their succession data from time to time, noting some of the changes which have occurred. If you maintain your own micro-aquarium you can determine the timing of discussions. When you observe a rather dramatic event such as an overnight change in numbers or a sudden appearance of many new froms, find out what is happening in the students' cultures. You may also expect the students to raise questions about some changes they have observed. Use these discussion sessions to maintain interest and excitement.

The day before the class begins the more systematic study, have the students feed each culture with several grains of rice, or a pinch of brewer's yeast, or a few (3-4) flakes or cereal. (They should use only one type of food per sample.) After this initial feeding do not have the students feed them again. **Ask the students to predict what will happen now that the organisms have been fed.**

In order that the students obtain **meaningful** information about what happens to populations of organisms in their samples of pond water, they will need to sample the populations in a systematic way. The next section, "Sampling", outlines some important points you will want to go over with the students as they develop their own sampling procedures.





B. Sampling

The micro-aquariums which the members of the class have set up are small representations of natural habitats. Using the sampling procedures which follow, the students will see that populations--or the numbers of organisms in the aquariums--change over a period of time. These changes are related to many factors, including availability of food, the fact that one organism might eat another, availability of heat, light, moisture, chemicals, and so forth.

As mentioned in the introduction to this unit, succession involves a change in numbers and types of community members. Casual observation can reveal changes in numbers of organisms in the students' samples. The water will turn cloudy when many forms are present and it will clear when they die. General observations, however, are not sufficient for knowing which form "bloomed" suddenly or which form died. Also, growth and/or death could occur in one part of an aquarium but not in another. Again, this will not be apparent through casual observation. Therefore, in order to discover more exactly the nature of a change, each aquarium must be sampled carefully and systematically.

If samples are drawn from different parts of the culture (e.g. the top and the bottom of a jar), the samples are apt to yield different types of organisms as well as different numbers of those types. Ideally, to get an overall picture of what's going on throughout the whole aquarium, the most accurate method of sampling would involve actually taking samples from different parts of the culture. But for the students, this could become rather tedious. For purposes of this study, it would be suitable for them to determine the most populous portion of their cultures and then limit their sample-taking to that area only.

To introduce to the students the importance of standardized sampling, have them recall the predictions they have made about what might happen if the cultures were fed. Ask how they will know if something has happened. Why do they think it might be a good idea to follow the events in the culture for several weeks? How would each student propose to do this? You will want to elicit suggestions for a standard sampling method as part of the student's proposed study. For instance, if they suggest the cultures be examined every day, you could ask yow they would examine them. Can they possibly examine the entire contents or, if not, what part could be checked? Have they any ideas about a "best" part of their culture?* Ask if the "best" part would be where many or few organisms are found.

Perhaps "bestness" can now be determined if each student carefully draws samples from relatively distinct areas within his aquarium. These areas might be the top, middle, and bottom portions. Another area might be somewhere in the midst of the debris. Area sampling can be accomplished easily by placing a finger over the top of the straw sampler before inserting it in the culture and keeping the finger across the top until the straw reaches the desired spot in the culture. At this point the finger should be removed for a moment and then placed back across the opening. Then the straw should be removed. The straw should now contain a sample of the culture taken from the desired spot in the aquaruim.

Once the samples are drawn it will be the responsibility of the students to evaluate them. Ask such questions as "Where are the greatest variety of organisms?" In order to evaluate their samples, each student will want to make slides from water taken at different points in his aquarium and observe his slides under a microscope. This activity will raise some questions about why the organisms "prefer" one spot to another. Suggest to those interested that they try experimenting with some other water to see if they could discover possible explanations.

*"Best" is an arbitrary word. We have used it because students generally think in a qualitative rather than quantitative fashion, although they may be intending a quantitative description. When they determine what "bestness" entails, another descriptive word or phrase should be substituted (e.g., "most dense.")

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For the population estimation procedures which follow, each student, individually, should agree to take all his samples only from that spot in his own aquarium which he considers "best". It is assumed that the spot which each student chooses will contain a diversity of forms occurring in relatively large numbers. A student whose aquarium is a quart jar might decide that his best sample area is that spot just below the water line, in the center of the water surface. Another student might discover that the same depth is right, but that his best spot is near one side of the jar at a point he might mark with a grease pencil or piece of tape. Again, no matter which place the individual student chooses, all of his samples in the following activities should come from that same spot.

This method for determining a means of sampling and choice of site is a compromise. Its aim is to have the students recognize the need to standardize the sampling procedure. By taking samples from the same spot in his aquarium over a period of time, each student will have a better chance of detecting changes which occur in the populations of organisms in that sample area. In other words, each student will be able to observe, to some extent, natural selection and succession in a small community. At the end of this investigation, ask the students what they might have found if they had chosen different spots to sample each day.

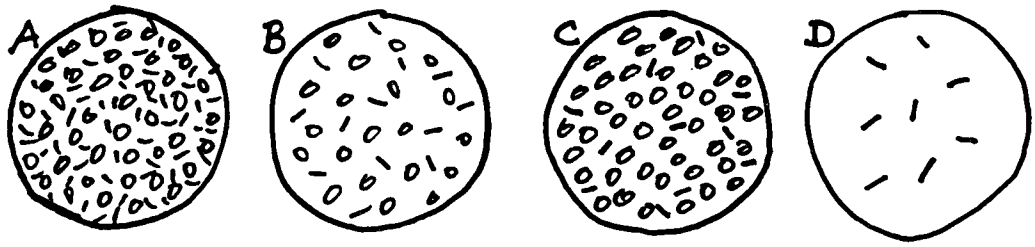
C. Population Estimation

After the class has determined a sampling spot and a procedure, a method must be devised for estimating the numbers of individual organisms in each sample. The purpose of making population estimates is to help each student determine when and if changes are occurring in the numbers of organisms in a particular section of his aquarium. The procedures for estimating need not be too precise, but they should be reliable enough to indicate clearly when a population change occurs.

The following section outlines a method for estimating numbers of organisms by using arbitrary standards. This method would probably be most workable with younger children. Older students should suggest their own methods. Any estimating procedure will be appropriate as long as it is fairly accurate and can reflect trends in population growth and decline.

Estimating by using arbitrary standards

Observe the drawings below:



All of these drawings represent different views of slides which might be made from a single pond water aquarium sampled on differnt days, at the same spot in the aquarium. The slides are not in any particular order. All views are at the same magnification. The views are not intended to represent specific kinds of organisms. Rather, they are meant to represent various degrees of density (or total population) that might be noted in different samples.

Sketch similar drawings on the blackboard for the students to observe. You might ask them what they think the drawings represent. Once the general meaning of the sketches is understood ask the class to put them into some kind of order.

There are several possible ways to order the drawings. One way would involve ordering on the basis of the number of a certain type of organism. Propably the most obvious method would be to order them according to the total number of all forms contained in each field of view. If the four drawings were ordered on this basis of total numbers,

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ranging from fewest to most, the order would be approximately DBCA.

Now have each student prepare a slide from his sample area. All microscopes should be adjusted to the **same magnification**. Next have the students estimate how many forms they can see. (Guesses will vary widely both with samples and with the students' ability to estimate.) The estimates should be recorded. Now have the students readjust their microscopes to a higher magnification. Again ask the students to estimate how many organisms they see. (Estimates should be lower this time.)

ASK THE STUDENTS:

If you had to make daily estimations, which power would you use? Is the choice of specific power important? (Probably not except that at higher magnifications fewer organisms are seen, making estimates easier.) **Do you think it's more important to choose a specific power each time or to standardize the magnification so that the field size is the same each time estimates are made? Why?**

Return to the idea of ordering the drawings. Have the students select a magnification which seems to be the best for making estimates. After they are focused on a field, ask them to compare what they see with one of the drawings on the board. They must think in terms of the **density**--or total numbers--of organisms. Do they see very few or many organisms? Ask the students which blackboard drawing they think is the most representative of their field of view. after they have decided, suggest that they check one another's samples. Provide time for checking and comparing. Each student will have looked through his microscope and then selected from the board the view he feels is "most representative" of his own field of view. To what extent do the students seem to agree with each other's choices? Give the students a short time to discuss their choices among themselves. Discussion should further help to acquaint the students with the procedure of choosing the "most representative" view.

The class has now been provided with one means of **estimating total population** of all organisms in a drop of water from a pond water aquarium. In the days ahead, as outlined in the "Keeping Records" section which follows, you will want to have each student take a water sample from the sample area of his aquarium, make a slide, and estimate total population. If your students are using the drawings you have put on the board for making their estimates, they should check the population in their sample area every day or two and then compare what they see with the drawings. Each students should determine which drawing most closely resembles the population in the sample area of his aquarium on the various days. By doing this for a number of days, they should each have a record of relative increases or decreases of population in their sample area.

In addition to recording changes in **total** population, you will want the students to make estimates of the numbers of particular types of organisms when compared to all other types in a mixture. Few slides will show only one kind of organism. Instead, several kinds will probably be visible on the slides. The key to estimating relative numbers of particular organisms and comparing these to the total population lies in the student's abilities to distinguish between varieties. Sometimes this is not easy to do, so you won't be able to insist on a great deal of proficiency. Absolute classification is neither necessary nor desired for this investigation. It is important, however, for the students to be familiar enough with the organisms so that they can make a fairly good guess as to which one is the most abundant at a given time. In order to make this process less complicated, the identification of each type of organism can be relative. For example, all "tiny " forms might be counted as one type. All forms having similar characteristics such as legs, "feelers," etc. could together constitute another type.

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D. Keeping Records

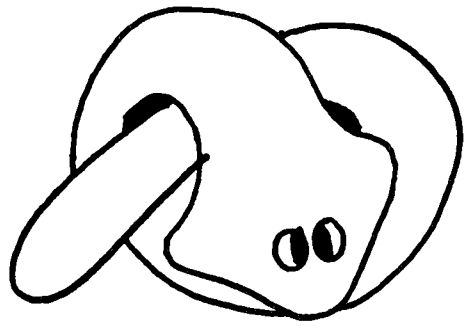
Over the next several weeks the students will be taking smaples, making slides, and looking at those slides under the microscope to detect changes in numbers and types of organisms. After a period of time, some of the students should be able to notice patterns of succession. Each student should keep recprds of all his observations. The records should consist of several items: (1) date, (2) types of organisms observed and their relative numbers, (3) description or notes about the total population, and (4) general observations of the water.

The simplest method for keeping the records is to construct a data chart where observations are entered at the appropriate place on the days when observations are made.

The students may decide to take a sample every day, or once every two or three days. Remind each child that on each day he wishes to sample his population, he will have to take a fresh water sample from his aquarium sample area, make a new slide, and then record his findings for that particular day.

In the back of the book we have presented drawings of six possible microscope views. The drawings show the kinds of organisms that might be found if you were to take samples from a single aquarium over a period of time. As indicated ealier, there is no way to predict exactly what organisms will be found in a given aquarium. Thus, the six drawings represent only reasonable possibilities. They are included in the unit to illustrate the kinds of drawings students might make as well as the kinds of written data they would record. Seen as a group, the six drawings constitute one pattern of events that might take place in a single aquarium over a period of three to four weeks. A blank data sheet which you can use for duplicating copies to give the students for their studies is included in the back of the book.

Refer for a moment to the drawing and chart in the back of the book. Under the heading "Organisms Observed," the children would enter the designations they have chosen for commonly appearing organisms. The students may want to use descriptive words or drawings. If they decide to assign names to the organisms for use during the study, they sould agree on names which will be used by all the students in designating each particular type of organism. Under the column headed "Number," any terms descriptive of quantiy may be used. Under "Descriptive of Population," the students may either describe changes they note in the total population or they may designate one of the "representive drawings which most closely resembles the density of their populations on a given day. The final column is included so that some correlations between populations and water conditions can be made at the conclusion of the unit.



Discussion of Results

You will have to use your judgment as to when the investigation should be concluded. Four to five weeks is an average time period for having the students take samples. Check the students' records from time to time to see if changes are taking place. When you feel that there are enough changes to illustrate the point that succession occurs, you should begin a discussion of the results. Refer to the initial predictions the students made after the cultures were fed. Did anyone find his predictions to be correct or close?

During the discussion the children will want to report their findings. As they relate what they have found, try to discover whether they noticed any **cycle of events** occuring.

You might bring out this idea of cycles by having each student report his results according to the daily sequence of events. Ask: Beginning a day or two after the cultures were fed, what happened? And after three of four days? etc. As reports are made, check to see how many students found the same or similar events happening at the same time. Record there reports on the board so that the students may see one another's results.

The major point to bring out in class discussion is that **change occured.** Infact, two types of change may have been observed: (1) changes in total numbers of organisms, and (2) changes in types of organisms. Ask: Did there seem to be any **pattern** or **sequence** to the changes?

It is difficult to predict what type of pattern may have emerged because the factors which would affect that pattern vary widely from class and depend to a great extent upon the contents of the water samples. But some sort of generalized pattern will exist. Many investigators have found the following sequence to be characteristic of the events observed in their studies:

1. Initial phase before feeding; a few tiny organisms plus some larger multicellular forms. Water clear.
2. After feeding; profusion of the very tiny organisms. Water turns cloudy.
3. Several days later; appearance of larger single-celled forms. Water turning clearer.
4. One week to ten days after feeding; predominance of large single-celled forms such as the Paramecium and related organisms.
5. Three weeks after feeding; beginning of mixed form stage. Water clear, fewer Paramecium and increasing numbers of larger multicellular forms such as rotifers, small crustaceans, etc.
6. Month later; mixed population, fewer numbers of everything. This stage resembles the initial phase.

The above is a very general description of what might have happened. It is by no means the only sequence of events possible. Some of the phases may not have appeared in your class samples; others may have lasted for a considerably longer or shorter period of time; and, lastly there may not have been any obvious phasing at all.

Once all the data are put in a generalized form and made clear to the class, ask the students what would happen if they fed their cultures again and followed events much as they have in the previous activities.

ASK THE STUDENTS:

If you were to feed the cultures again, do you think you would see similar things happening?
Do you think the pond has changed since we were there?
Should we expect the events in the micro-aquariums to mirror those in the pond?
What are some of the important conditions of life in the pond which are not present in the micro-aquariums? (The students should be aware of the fact that natural conditions of existence cannot be wholly duplicated in

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fact that natural conditions of existence cannot be wholly duplicated in the classroom. But they would be correct in suggesting that the kinds of things which happen in the natural setting are similar to those in the classroom aquariums.)

Is change characteristic of ponds alone or is it observable in other parts of the natural world?

What are some other examples of change you have observed?

Perhaps the most common and dramatic changes which the students will think of are seasonal ones. These are good examples of change since they are predictable and recurrent. In this sense, seasonal changes are similar to the cyclic changes which occur among pond organisms.

Through discussion the students should become aware of the concept of change and how it relates to events in the natural community. You should also extend the discussion to include man-made communities. Finally, the class might observe and describe changes in other micro-communities. Finally, the class might observe and describe changes in other micro-communities such as rotting logs, forest floor litter, or other decaying vegetable matter.

Additional Investigations

Below are some further investigations some of your students may want to try.

1. Altering the Environmental Conditions

- **A.** Light (keep cultures in the dark)
- **B.** Temperature (maintain some cultures in a refrigerator)
- **C.** Condition of the water (see what effect the addition of a pinch of baking soda has on the successional pattern)
- **D.** Food supply (see if too much food will adversely affect a culture)
- **E.** Air (observe the events in a tightly capped micro-aquarium)

2. Investigating a Single Organism

3. Investigating Other Events in the Aquarium

- **A.** Food chains
- **B.** Growth and reproduction of organisms
- **C.** Role of plant life
- **D.** Behavior of larger forms

Water Sample Collection Card

Student Name _____

Date of Collection _____

Collection Site Description _____

_____

_____

_____

_____

_____

Weather _____

_____

_____

_____

Condition of Water _____

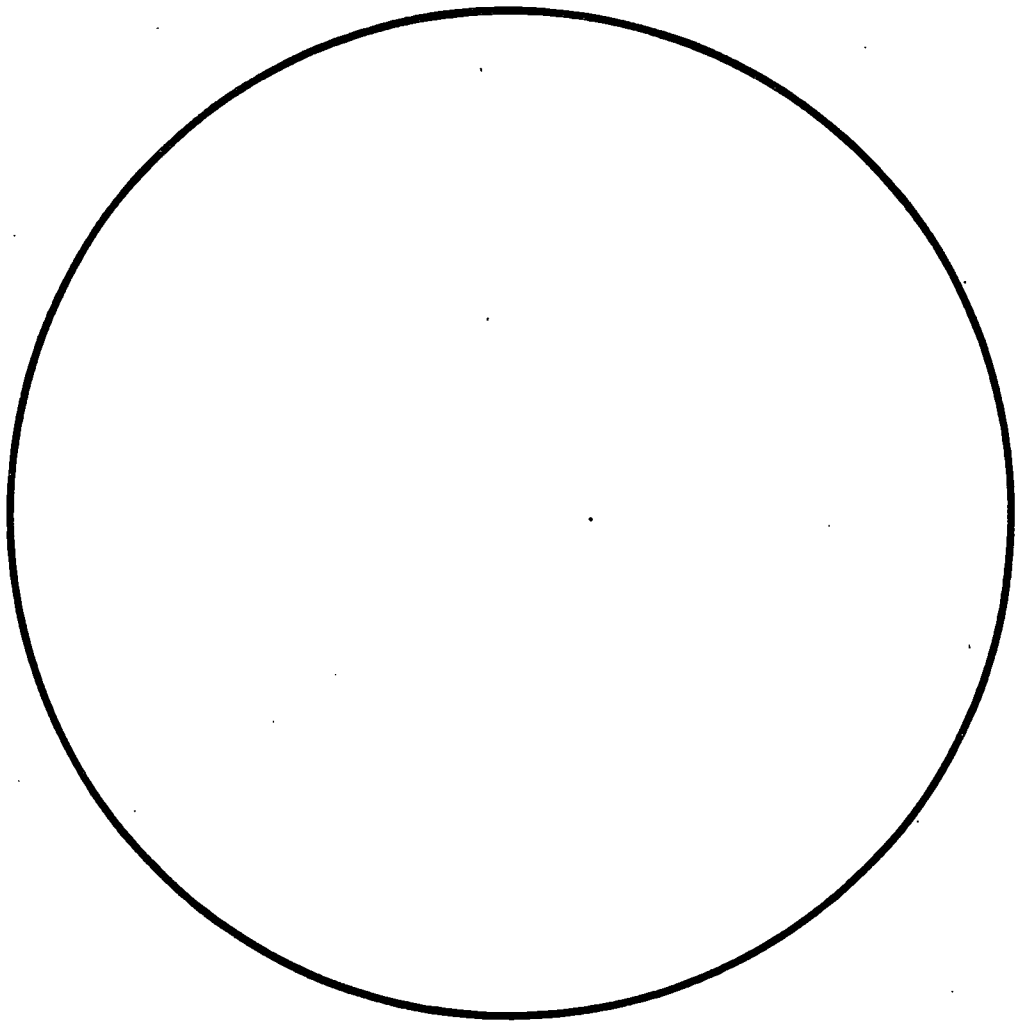
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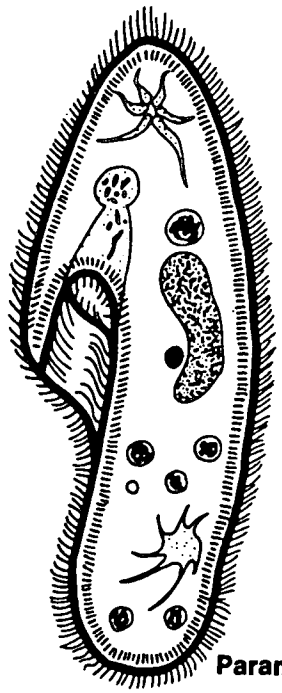
_____

DAY _____

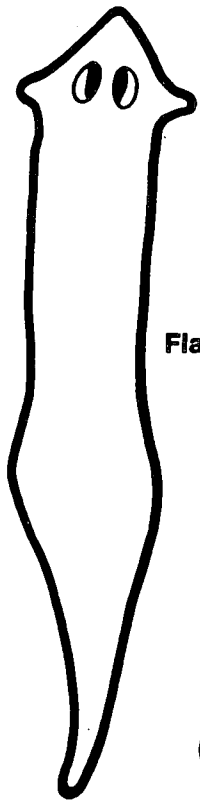
DATA CHART



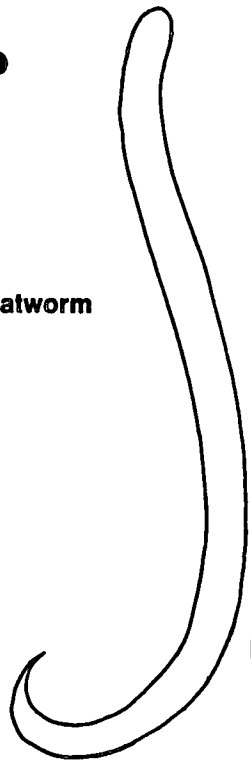
Date	Organisms Observed	Number	Description of Population	Water Conditions



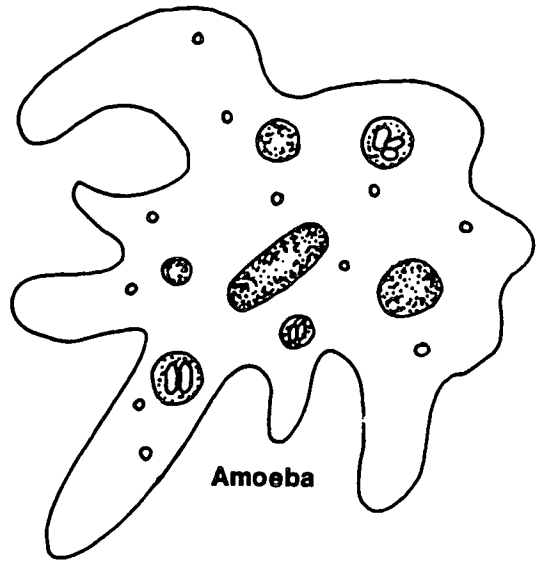
Paramecium



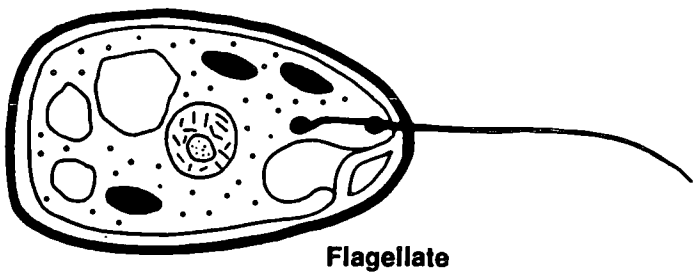
Flatworm



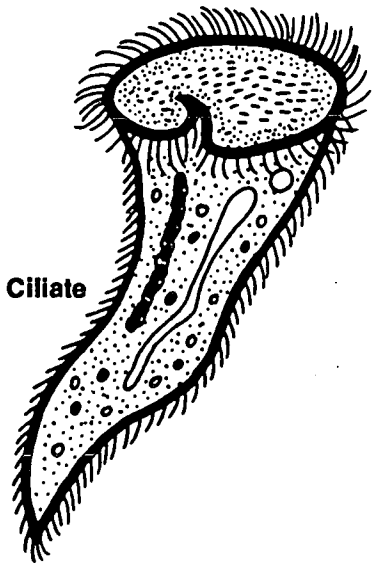
Roundworm



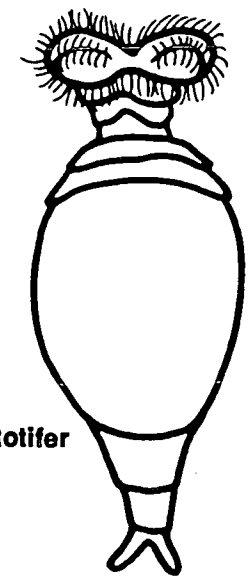
Amoeba



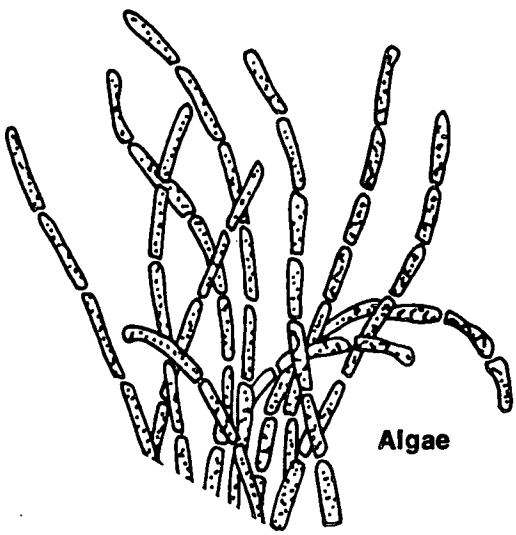
Flagellate



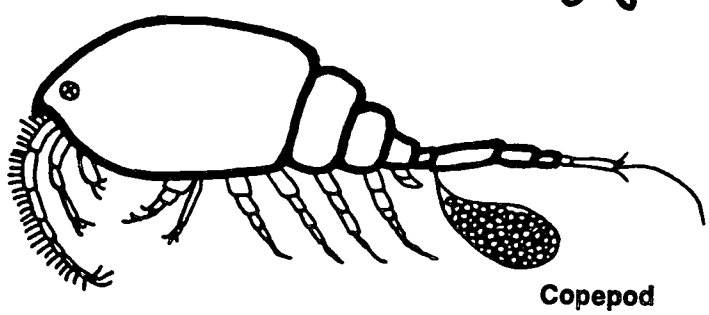
Ciliate



Rotifer



Algae



Copepod

Vacant Lot Studies

An Environmental Investigation

BY
NATIONAL WILDLIFE FEDERATION
MINNESOTA ENVIRONMENTAL SCIENCES FOUNDATION, INC.

Vacant Lot Studies was developed to shatter some long-held views that environmental education is suitable only "out there" -- in the country, the mountains, the desert or beaches -- in places except the towns where we live. Most of our environmental problems exist or start where the people are; so to exclude from environmental studies the places where we live and spend most of our time, is to misunderstand what the environment is.

Also, we must not expect meaningful environmental learning to focus only on the spectacular natural sights, objects and creatures which we seldom see. People may get excited about seeing a grizzly bear, a brightly colored bird or the Grand Canyon, but there can be a great fascination in less spectacular, everyday things, and peoples' relationship to them. As a matter of fact, when such relationships are observed and studied, they are often more exciting, and more meaningful, to city residents.

INTRODUCTION

There is a growing belief among educators that children learn best in familiar surroundings using subject materials which are well known to them. At first, the problem of meeting the city child on his own grounds may seem difficult for the environmental educator. The city provides few opportunities for demonstrating some of the traditional environmental problems such as forest management , crop destruction by erosion, or wildlife management. This hardly means that the city has nothing to teach us about the environment; it's just that we must develop a new approach. Some of these hew approaches will demand that we begin seeing the city in a positive way, not for what it lacks, but rather for what it offers as an outdoor classroom.

This unit on **Vacant Lot Studies** offers some new views of the city, It gives the city child a chance to understand ecology without ignoring the apparent influence of man. The suggested activities are intended to help instill this feeling for ecology by involving the children with he study of their own immediate environment. Since ecology is the relationship of all living things to each other and to their environment, it includes man and his impact upon earth. In guiding children through these investigations, we will need to break down the artificial barriers that have been erected between natural science, mathematics, social studies and economics. For man, ecology encompasses all of these disciplines.

One of the primary tools which students should have at hand to enjoy and appreciate this unit, is a firm grasp of grid mapping. If they don't have an adequate background in this area, some preliminary activities on grid systems, map drawing, and grid games are furnished at the end of this unit. With this groundwork, your class will be ready to begin.

Surely somewhere near your school there will be a vacant lot. Any size, shape, or condition will do. Just claim it for your own temporary use (check first with owners for permission), establish squatters' rights and start these studies.

Vacant Lot Studies

Setting Up Plots

MATERIALS

a City lot	**48 foot lengths of rope, knotted at 12' intervals**
12" cardboard squares	**nails--10 penney**
hammer	**large spikes or stakes**

The vacant lot studies will be more manageable if the lot is divided into plots which are 12 feet square. Divide the class into teams and assign each to a plot.

The widths of city lots usually run from 40 to 115 feet, and the depths vary even more. If five subplots, each 12 feet square, are designated within the lot and studied, the class can get a good sampling of the nature and content of the lot as a whole. On larger lots, it will be possible to make several additional plots without crowding anyone. This way the teams can be small and each student more involved. Arrange one plot for each team.

One way to locate the plots on the lot is to imagine a large X drawn across the lot. Locate one plot where the legs cross, and one near each of the outer ends of the X legs. If you are making more than five plots, locate the extras at random between the initial five. Provide each team with:

a 48 foot length of rope, knotted every 12'
a square of cardboard
nails

Your class's first problem will be to mark off a 12' square and make sure it really is square. A little practice on school grounds beforehand would be wise. Use the cardboard square, and nail it down at a corner. Then run 12' of rope out along the edge of the cardboard, and have a team member stand at the end of the rope. A second child then takes the rope from the first, and walks the opposite direction until the rope is straight along the other edge of the cardboard. The rope should be pulled tight until flush along the opposite edges of the cardboard, and then staked down at the 12' length. Continue moving and staking the cardboard and the rope until four corners are staked in this manner.

Now each team can conduct the unit's activities within the boundaries of its own plot. You should continually encourage the teams to compare their plots and the data they gather. Data sheets are included at the end the activity.

Comparisons between plots are often more meaningful if a map has been drawn. Each team can then record the information from its data sheet onto its own map. Instructions for making maps are also at the end of this unit. Mapping of the data will be suggested specifically in some of the individual activities, but it is highly recommended for all of the activities.

Explain to the children not to trample or disrupt their plot, but rather sit down and carefully examine the area.

Litter On The Vacant Lot

MATERIALS
plastic bags
paper for labels
pens or pencils

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A vacant lot often displays man's knack for littering his environment with trash. Obsolete and worn out materials, ranging from bits of paper to old bed springs and junk cars, often find their way onto a vacant lot.
Living plants and animals on the lot may depend on the litter, or be altered by it.

In a vacant lot, children can see the interactions between man, his litter and the plants and animals on the lot. These interactions exist because litter changes the environment in many ways. It blocks light, increases moisture, introduces different materials into the soil, and provides support. Ask the children to imagine what the vacant lot would be like without litter.

The children will probably find examples of adaptations caused by the litter. For example, a pigweed which is rooted in the soil but growing over a sheet of tar paper does not have to compete for sun, food, or water with other plants. The tar paper occupies the space of the would-be competitors. A plant rooted in a small pocket of soil in a brick may not be able to grow elsewhere in the lot. A plant bending around a board in order to escape its shade looks very different from its brother growing in full sunlight. The students may find plants and animals depending upon litter for support, increased moisture, reduced light and other benefits.

Decomposition is also noteworthy. Evidences of it can be seen in old boards and vegetative wastes. These rotting materials will change the composition of the soil in some spots.

The data sheet at the end of the unit will help the students plan their investigation. To allow for later studies, always ask the class to replace any object they pick up. Discuss the terms **environment, depend upon, related to, affected by** as they are used in the data sheet. The students might complete several data sheets for one piece of litter.

Visitors To The Vacant Lot

A. Burrows

The teams should check the plot carefully for burrows and tunnels. Have the students look: 1: around the base of fences
2: around and under cement blocks
3: in hollows, ground depressions, sides of banks
4: around tree roots, under plants, under grasses

The students should make notes on the appearance and diameter of a burrow. They should locate and count all similar burrows found throughout the plot. Are they all found in the same kind of surroundings? Have the class map the locations.

B. Droppings

Have the student find out what animal droppings can be found on their plot. Do dogs leave droppings there? Do they use one particular part of the plot? If one area is used more than the others, what are the characteristics of it? Have they seen dogs using this area?

Have the teams check around the entrances of the burrows they located. Can they find any droppings? Ask the class why an animal might come outside to defecate. Are the same droppings found near other burrows? Does this evidence provide clues about what kind of animal lives in the burrows?

Rabbit droppings are black-brown, round and pea-size. If the class finds any, have them collect them in a plastic bag (these are not dirty or smelly, unless very fresh; it is only plant matter). Label the bags, indicating where they were found.

The students should look for bird droppings on the tops and sides of fences, boards, rocks, broad leaves and other flat surfaces. What seem to be favorite perching areas? Ask what reasons a bird might have for choosing a particular perch. Watch these perches to observe the birds which use them.

C. Other Signs of Animals

MATERIALS

food--raw meat, oatmeal, peanut butter		
fine powdered soil	shelf paper	clipboard
garden trowels	graph paper	water
detergent	flour, baby powder	fly paper
tiles or flat boards	alcohol	white liquid glue
cardboard	soup or juice cans	

BIRDS: Watch the birds closely and see what they do when they come to the lot. Ask the class why birds might visit the lot. Are there trees, bushes nearby for nesting? Is there food? Have the class observe bird nests or bird feeding in the lot. Are there different kinds of birds using the lot? What might be the different reasons these birds are here?
CATS: Ask why a cat might use the lot, and what its presence means for the rest of the animals there.
RABBITS: If you have found rabbit pellets, you have evidence they use the lot too. Rabbit trails are usually about four inches wide and found in deep grass which is matted, with droppings around. Can the students find any trails which might have been made by rabbits? Can they guess where the rabbit was going when he made the trail? Why do you think he was going there? Record these trails on the maps of the plots.
TRACKS AND FOOD: The students can prepare a list of foods which might be eaten by animals that visit the lot, and each student can bring some of the foods from home. Foods which might be used are: raw meat to attract dogs and cats, rats, shrews and scavenger birds; oatmeal or peanut butter mixed with seeds to attract mice, moles, shrews, birds and insects. Place the food far apart in your plot.

The tracks of visiting animals can often be studied by sprinkling dry, fine powdered soil, flour or baby powder around the food. Point out to the class that some animals may eat the flour, and others might be repelled by these substances.

Another way of recording the tracks of visitors is with smoked paper. This is the most effective method, but the most difficult to use. Hold shelf paper over a candle until soot forms on one side. This carbon, or soot will record anything that touches its surface. Smoked paper is sometimes too effective, because it will show everything from insect tracks to dirt blown by the wind, etc.

Have the students check their baits early the next day. Which food was eaten? Are there footprints recorded? Try the same test two or three times for conclusive results.
FIELD MICE: Field mice may be living in the vacant lot you are studying. A field mouse population is almost certain if the lot is low and moist with dense vegetation.

Have each team look carefully for runways which criss-cross the ground surface just below the vegetation. They should notice entrances which look like round holes or separations in the vegetation. They can follow the runways by carefully parting the plants. Droppings, nests, and entrances to underground tunnels will be found along the runway.

It is easier to locate runways when there is snow on the ground. The best snow conditions for exploring runways occur during early spring when the snow has melted down, with a crust on top. The raised outline of runways can often be seen on the surface of the snow, and the entrances will appear as round holes or cracks in the snow. You might even see mouse tracks on the surface after a fresh snowfall.

Have the students use garden trowel to remove snowy roofs from the runways. Record their finds in a notebook. Field mouse runways can easily be mapped by using a grid system or graph paper.
BUGS: Select one or more of the following means of trapping insects and other creatures that crawl or fly through the lot.

1) Water and detergent trap: You will need soup or juice cans which are 3/4 filled with water. A drop of liquid detergent will reduce

surface tension so that insects sink when they land on the water surface. Some of these cans should be buried level with the ground surface to catch walking insects. Others should be placed at random around the plot.

2) Sticky traps: Fly paper cut in squares make a good trap to fasten to leaves, tree trunks, and other places which would be too difficult to reach with other traps.

3) Plaque traps: Have each team set tiles or flat boards at random around the lot and check under them after a week or so. Surface bugs, such as sowbugs, millipedes, and slugs may have taken up residence. Rocks and other materials which are already in the lot may yield these bugs also.

4) Careful Observation: Have the students look on the ground and under things, on trees and leaves and any other place which might harbor an insect.

5) Insect Nets: The students should swing an insect net so that it brushes the surface of the plants in each plot. They will be surprised at the number of insects they didn't know were there. See the Habitat/Transect Study section in this unit for making and using the nets.

Map the locations of the insects caught, and either release them or draw them so they can be identified later. A museum type collection could also be made using a kill jar and white board with labels. This activity would be suitable for older children, check with the library or museum for proper methods and supply sources.

Plants in the Vacant Lot

A. Variation in Plant Types

MATERIALS

tape	large sheet of paper	heavy books	cardboard
	sheet of plastic	blueprint paper	
	bucket of water	dark folder	

Vacant lots usually contain a great variety of plant types. The children can survey the types of plants by forming a plant key. When each team has finished making a plant key, it will have a chart that graphically shows all the kinds of plants located in its plot. One of the aims here is to hep the student discover what a wide variety of plants can found in a relatively small area of land.

Forming a Key -- Here are three suggestions:

Method 1> Each team should search its plot and select one sample of each type of plant. These plants should be taped to a large sheet of paper which is centrally located.

On this central key, only one sample of each plant type should be used. The child who brings the first sample of each plant type should invent and draw a symbol to represent that plant type. This symbol should be used during all future studies, mapping, or record-keeping concerning the vacant lot.

Method 2> Each team should search its plot and select two plants of each type. One of each should be taped to a large sheet of paper, as in Method 1. The second plant should be pressed under heavy books for two weeks. This one can then be used to replace the plant which is on the key. Dried plants last longer if protected by a sheet of plastic.

Method 3> Each team should search its plot and select one sample of each type of plant. When this has been completed, return to the classroom to make a blueprint of each plant.

To blueprint plants, each student should have a piece of blueprint paper, in a dark folder to protect it, and a bucket of water. The paper should be placed on cardboard, and the plant on the paper. Cover it with clear plastic. Expose the plant to the sun, 1 to 5 minutes depending on the brightness of the day. Overhead projectors can be substituted for sun. When the exposure is complete, dip the paper in water to fix it, then hang to dry. After drying, the prints can be mounted and assigned symbols. A uniform key should be used for all the maps, charts or graphs

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which will be used during the unit. Plant samples can be taped to the key beside the blueprint.

Blueprinting the plants make the key more permanent, and it is fun for the students to do. the blueprinting process might even be expanded into an art project (see Nature's Part in Art).

There are a variety of plants to be found in a vacant lot; check with the local Forest Service, State Parks or Lands office, or even the public works department for common plants in your area. Some possibilities include:

Russian thistle	Leafy spurge	festal
clover	dandelion	knapweed
crested wheatgrass	wild rye	wild rhubarb
deadly nightshade	white campion	milkweed
pigweed	goldenrod	plantain
oxalis	nettles	wild grasses

You might also find plants that have escaped from neighboring yards and gardens. Naming the plants is not necessary; a simple picture key should be available from the local library.

B. Variation within One Plant Type:

Up to this point, the students have made a survey of all the plants within their plots. Now they will choose **one** plant and examine the variation among several specimens of that type.

The various specimens of a single plant type will vary in height, size, color, etc. depending on their locations in the lot. The students should be encouraged to explore why there is so much variety. Many problems can arise during a study of plant variation. The appropriate number of samples must be determined; the correct spots for sampling must be selected; and all contributing factors must be considered. Choose only one characteristic to study at a time. Students should be responsible for collecting and measuring the variation within their own plot.

Sampling the Study Plant: The plants chosen for measurement should selected at random. If you were to look specifically for certain plant variation, you might tend to select plants that exhibit extremes only.

Each group will study five specimens of the same plant. Try to reach a group decision about the best way to choose these five plants at random. The students might close their eyes and feel for plants; they might toss a ring and see if it touches the right type of plant; they could run a string out and collect only those plants touching the string. See if the class can come up with a sampling method.

Measuring the Variation in the Study Plant: After the class has selected their plants and the feature they want to study, begin a discussion about how to measure the variation. Everyone must use the same technique to get valid results.

Each team should select five plants from their study plots and measure with the method chosen. Ask if any patterns appear. Do plants grow taller in one plot and short ones in another? Are larger leaves found in one plot more than another? Try the sampling method with one or two different plants which exhibit other variations. Data sheets should be kept for recording information. Try graphing the variations on charts. Encourage discussion as to why such variations occur, and the class making further investigations on their own.

C. Succession and Seasonal Change

MATERIALS

string crayons yardsticks rope spikes
12"x 12" mapping sheets with cardboard backing
flags or markers

The natural change in plant population that occurs over a period of time is called succession. The extent of succession that occurs on a lot during one year will depend upon when and how the lot was cleared. A lot

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cleared by a bulldozer during the fall or summer will show a lot of succession. A lot vacant for several years will show less evidence, and identification of succession may be hard to see by the entire class. A study of succession at different times in the school year will be more visible during the seasons.

The most effective way to study succession is to complete several vegetation maps for fall, winter, early spring and late spring. Classes during following years will see a broader picture of succession if they can refer to maps and records saved from earlier classes. A very thorough study of succession could result from the survey of a vacant lot many years after it is cleared.

To make a vegetation map of the lot the student will need to make a plant key; choose a way of counting numbers of plants; and map vegetation types.

1) **PLANT KEY** -- a plant key can be prepared using one of the methods found on the first page of this sections under Variation in Plant Types.

2) **ESTIMATING NUMBERS** -- encourage each team to devise a key for estimating the numbers of plants in its plot. Obviously, it would be a tedious hob to count them all. Then, during class, select the best key. It should show individual plants, large groups of plant, and those that completely cover a patch of ground. One uniform key should be used by all the teams. Your key might be similar to the following:

1 - 2 plants = red
3 - 10 plants = blue
11 - 20 plants = green
thick cover = yellow
bare ground = blank (white)

A plant is recorded on the map by drawing its symbol from the class key. Use the color which represents the plant population density. In the case of thick cover, use yellow cross-hatching and draw the symbol for the prevalent plant type in yellow on top of the cross-hatching.

3) **MAPPING THE VEGETATION TYPES** -- Each group can map the types of vegetation in its plot by using the grid method. If you feel your class needs some preliminary work in gridding before mapping their plots, refer to the end of this unit.

Each team should have string, spikes, and 12"X 12" mapping sheets with cardboard backing. Mapping sheets can be made by trimming down larger drawing paper.

a. Each team should grid its 12 foot square plot into 3 foot square sections. Yardsticks and rope will help in setting up the section. Mark each corner with a spike.

b. Place a flag of some type on one corner of the plot. The first section in this corner is number one. All other sections are numbered consecutively through 16.

c. Each group should grid their 12 inch square map into three inch square sections. These are numbered through 16 like the plot.

d. Using the grid as a guide, draw all thickly covered areas with yellow crosshatching as before.

e. Draw the symbols for all other plants in the correct sections, using the color which shows their density. If they fall within the cross-hatched area, draw their symbol on top of the crosshatching.

When the maps are complete, start a group discussion about similarities and differences between plots. The students might compile a list of plants which are found in all the plot, most of the plots, and those found only in one or two plots. These comparisons can be made for all the plot maps of one lot. Comparison can also be made between lots, if your class is studying more than one vacant lot.

Allow enough time for a complete discussion of similarities and differences. Think about why plants are distributed in certain ways and how man is involved in this process.

Have the student repeat the mapping procedure several months later. Ask the class: do the maps turn out the same as the one which were made earlier? Has there been change in the pattern of vegetation? Have some

plants appeared that weren't there before? Are bare spots of earth being covered over by plants? What kinds of plant first move onto bare spots? Have some plants moved into plots they weren't in before? Repeat the mapping procedure a third and maybe a fourth time at intervals over several months.

The Community and the Vacant Lot

When the class has completed its studies of the animal and plant life on the vacant lot, have the students discuss how the lot affects the community.

Questions for discussion might include: What does the community know about the history of the lot? What feelings do neighborhood people express about the lot? What should be the future of the lot? What stories are told about the lot? How is the lot used by members of the community? What might be done with the lot to make it a more valuable part of the community? To answer many of these questions, your class should talk to the neighbors.

A. Interviewing Neighbors

MATERIALS

large sheet of newspaper black crayon

Discuss ways to tap community opinions. Suggest using a questionnaire, and then divide the class into groups to discuss what can be learned about the lot from the neighbors. Ask each group to prepare a questionnaire which might be used to learn these facts from a neighbor.

Each group can transfer its draft of a questionnaire to a large sheet of paper, and write with the large black crayon. Hang the sheets in front where the class can see them.

Work with the class to make a composite questionnaire, using the best features of each draft. Role playing can be helpful in testing the questions, so have some members of the class play the part of persons being interviewed. This will give the class an idea of whether the questions are worded properly. whether they are important enough, and if they are clear and understandable.

A sample questionnaire is at the end of this unit. It is in multiple choice format. When the writing has been done, begin to plant interview techniques.

If possible, go into town with a third of the class at a time. Plan to interview all the houses and apartments on the block containing the vacant lot. Try to plan your survey so that each student will have a chance to conduct at least one interview.

Keep students within sight at all times; never allow a student to enter a house.

B. Tabulating Results

As interviews are completed, questionnaire results can be displayed and tabulated on a class data sheet (refer to end of unit).

C. Evaluating the Survey

When the final tabulations are finished, try to evaluate the survey. Discuss any shortcomings of the questionnaire which might have become apparent.

Encourage students to contribute observations and thoughts they had, or situations they encountered during interviews. Were there any stories about the history of the lot? Any controversy? Investigate further and interesting answers. Can your class reach any conclusions about the vacant lot and its past-present-or-future uses on the basis of the survey and its evaluation?

Your class might want to send a report of its survey and any recommendations it might make, to some person or groups in the town--Lions Club, city council, Chamber of Commerce, parks and recreation Department, building inspector, newspaper.

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THE END OF THE UNIT

1. **Grid Mapping**
   A. Grid Systems

MATERIALS

desk top	string	masking tape
ruler	1" graph paper	

A grid system gives students a wonderful tool for mapping. A desk top map with a four inch grid can be made across the student's desk with string and masking tape. Cut the string into pieces which extend across the width and length of the desk. Space the strings four inches apart going in both directions (up and down, side to side). With masking tape, anchor the strings along the side of the desk.

Place several items (pencil, book, eraser, etc.) on the desk in random order. Then, use one-inch graph paper to draw the map of the desk top and the items on it.

It will be natural for you to teach the class how to number each space along the sides of the grid. If you don't teach this, the students will probably invent it on their own.

When they finish the maps, they should show accurate size and spacing relationships.

Now try the map using a similar grid with one-half inch graph paper. With most classes, it is best to reproduce the same map s you did with the one-inch paper. This will help emphasize the idea of scale.

By now the students should be able to draw the representation of an area using a grid, numbers, and different size scales.

B. Table Top Map

MATERIALS

table top	**tape**	**cardboard**

The next mapping experience can be table top map, in which the children plan a three-dimensional setting, establishing a grid and mapping on different size grid papers.

Using a table top or the floor, lay out the neighborhood around the school with tape to designate streets, and blocks or folded cardboard to represent houses and buildings. If your classroom has a tiled floor, take advantage of its built-in grid. Large tiles could represent one square block; smaller tiles can be grouped together to represent a block.

Landmarks, such as churches, schools, libraries can be designated with cardboard structures.

C. Classroom Map

MATERIALS

yardsticks	**masking tape**	**clothesline**	**twine**

Students can map their classroom using a grid. Start with one corner of the room. Using the yardstick, have the students place a piece of tape at one-yard intervals along each wall. Have the class assign a numeral, letter or symbol to each location and write this symbol on the tape. The masking tape should be placed at eye level so that everyone can see the markings from their desks. From these markers the students should try to imagine the grid that would criss-cross the room and then draw maps to show the layout of desks and other objects in the room.

If members of the class have difficulty, stretch clothesline, twine or string between markers to make the grid.

2. **GRID GAMES**

Materials

notebooks	colored toothpicks, buttons or small blocks

Grid games similar to checkers or chess can be introduced at any point during these activities. Encourage students to try and invent some on their own.

One game calls for two players to sit opposite each other with a large barrier such as a notebook set on end between them. One player establishes a grid size, and both players either draw the grid accordingly or use graph paper. Using colored toothpicks, buttons or small blocks the first player puts one piece on the grid and tells the second player where he is putting his piece. He includes the name of the item, color and location on the grid. The point of the game is to create and interesting design that can be duplicated by the second player from oral directions. Language and communication skills can also be developed.

3. MAP DRAWING

Materials

48 foot twine, knotted at 12 foot intervals — tape
4 large spikes — graph or mapping paper — tacks or nails
cardboard cut the same size as the graph paper — yardsticks
string which reaches across the mapping paper

In the preceding mapping activities, the square which designated the outline of the graph was already laid out for the students on a desk top or in the classroom. Now the teams must figure out how to make their own square in which to plot a map.

Give each team a set of the materials listed above. If you make your own graph paper, trim the drawing paper to 12"x 12" dimensions.

The game takes place on the school yard. Select an area of the lawn or playgrounds for each team's plot. Each team should make a square plot 12'x12'. Do the same way the vacant lot plot was set up.

When the perimeter of the plot is marked, the students can grid it using nails or tongue depressors and stretching twine between them.

A three foot grid is made by inserting nails or tongue depressors into the ground every three feet along the boundary of the plot. The result is a 12' square plot, divided into a three foot square grid. Have the class plan how to reproduce this 12' square on 12" graph paper.

Stick a piece of paper onto a nail in one of the corners and mark it as corner #1 for a reference while mapping. If there are not trees, slides or other objects on the 12' plot, several sizes of sheets of paper can be used as objects to be plotted on the map. Push nails through he papers to attach them to the ground and prevent them from blowing away. Place the papers at random on the plot and at various angles, with some sheets crossing from one section into another.

Each team should sketch the papers to scale in the correct grid section.

Remove each paper and replace it with an inconspicuous marker. Teams should switch plots and maps. Each team should attempt to replace the papers in the correct positions on the plot by using the map from the other team. Try switching plots several times. Discuss the reasons why some maps are hard to follow.

Repeat the game using objects other than sheets of paper. This time make a key for the objects and record only the key symbol on the map. The students won't have to draw the objects to scale with this kind of map.

Name.....

LITTER DATA SHEET

Draw a sketch showing the litter and a living thing you think might **depend upon** or **be affected by** the litter. Try to show how the two things are **related** to each other.

The litter

Describe the litter .....

.....

.....

List ways it might be changing the **environment** around and beneath it:

.....

.....

.....

List any evidence of the above environmental changes:

.....

.....

The living thing

Draw a sketch of just the living thing; if it is a plant, tape a leaf next to the sketch:

Describe how it **depends upon** or is **affected by** the litter: .....

.....

.....

.....

.....

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Name.....

HEIGHT VARIATION DATA SHEET

Plot..... Variation in leaf area of plant having the symbol .....

SAMPLE PLANT 1.

height .....

SAMPLE PLANT 2.

height .....

SAMPLE PLANT 3.

height .....

SAMPLE PLANT 4.

height .....

SAMPLE PLANT 5.

height ..... Average height .....

LEAF AREA VARIATION DATA SHEET

Plot..... Variation in height of plant having the symbol .....

SAMPLE PLANT 1.

area of first leaf .....
area of second leaf .....
area of third leaf .....
area of fourth leaf .....
area of fifth leaf .....
Average area of leaves.....

SAMPLE PLANT 2.

area of first leaf .....
area of second leaf .....
area of third leaf .....
area of fourth leaf .....
area of fifth leaf .....
Average area of leaves.....

SAMPLE PLANT 3.

area of first leaf .....
area of second leaf .....
area of third leaf .....
area of fourth leaf .....
area of fifth leaf .....
Average area of leaves.....

SAMPLE PLANT 4.

area of first leaf .....
area of second leaf .....
area of third leaf .....
area of fourth leaf .....
area of fifth leaf .....
Average area of leaves.....

SAMPLE PLANT 5.

area of first leaf .....
area of second leaf .....
area of third leaf .....
area of fourth leaf .....
area of fifth leaf .....
Average area of leaves.....

SAMPLE QUESTIONNAIRE

I'm from ..... School. We are making a study of the vacant lot which is on ..... Street. Would you answer a few questions about the lot for us?

1. Was there ever a building on the lot? (a) yes (b) no
2. What kind of a building was it? (a) house (b) apartment house (c) store (d) garage (e) other .....
3. Was the building (a) two-story or (b) one-story?
4. Were the building and yard (a) well kept? (b) fairly well kept? (c) poorly kept?
5. Was the building in use until it was torn down? (a) yes (b) no
6. If not, for about how long was it unoccupied before it was torn down? (a) less than six months (b) about a year (c) about two years (d) more than two years
7. Did it deteriorate in this time? (a) yes (b) no
8. Do you know how the building was removed? (a) burned (b) torn down by hand (c) torn down by machines (d) fell down by itself and debris was removed later (e) other .....
9. Do you know why the building was removed? (a) new building to be put up (b) old building was dangerous (c) to make way for a road (d) other .....
10. What do you think the lot might be used for to benefit the community? (a) park (b) playground (c) store (d) home (e) parking lot (f) dump (g) other .....
11. How long have you lived in the community?.....

TABULATION OF ANSWERS

Question	Total number for each answer						
	a	b	c	d	e	f	g
1.							
2.							
3.							
4.							
5.							
6.							
7.							
8.							
9.							
10.							
11.							

Now You're In Hot Water!

Investigation: Temperature Gradient

BY
OREGON STATE UNIVERSITY SEA GRANT COLLEGE PROGRAM
OREGON DEPARTMENT OF EDUCATION

Students will be able to construct an instrument capable of taking water temperature at different water depths and to use it to find the temperature gradient of a body of water. This will further reinforce the concept the people depend on water for life.

Allow about 2 class periods for this exercise, one for constructing and one for experimenting.

Integrating physical science and math can illustrate factors controlling density. It can also easily be used to show applications of gathered data and the function of tables and graphs to illustrate data accurately recorded at the study site.

Students will begin by making the instrument. First they will fill a liter bottle with enough sand to sink it when stoppered and filled with air. Attach one piece of cord to a water thermometer (tie the metal loop on the end) and around the neck of the bottle on the outside. Allow enough cord to enable withdrawal of the thermometer from the bottle and still remaining attached to the bottle. (See figure 1).

This attachment allows the descent of the stoppered bottle to the desired depth. When it reaches this depth, a sharp jerk on the line above will pull the stopper out, but will still hold the bottle.

Use the Instrument

1. Have students arrange thermometer inside bottle.
2. Place rubber stopper snugly in neck.
3. Start descent of bottle in water by slowly and gently letting line out.
4. Upon bottle reaching bottom, raise the bottle approximately 0.5 m and give the line a sudden, distinct jerk, thereby pulling the stopper from the neck of the bottle. This allows the outside water to enter the bottle and the thermometer to record its temperature. Observe the bubbles escaping to the surface to confirm that the stopper has pulled out.
5. Leave the bottle at this bottom position for approximately three minutes to be sure that all materials (glass, gravel, thermometer) have all assumed the ambient temperature.
6. While waiting, mark the depth by tying a piece of yarn tightly at the point where the cord comes out of the water.
7. After about three minutes, pull up the bottle with a swift, even motion.
8. Retrieve the thermometer and immediately record the temperature with the thermometer bulb remaining in the captured water.
9. To obtain the second depth temperature, take half the cord used for your first depth and again securely tie a piece of yarn at this point on the cord.
10. Lower the empty, stoppered bottle with the thermometer to the halfway point and repeat the procedure for release, down time, retrieval and reading process.
11. Repeat Step 10 for as many depths as desired and record each temperature. The last depth recorded should be close to the surface. The bottle must be submerged, placed at least 30-60 cm below the surface.
12. This temperature gradient data can be used to:

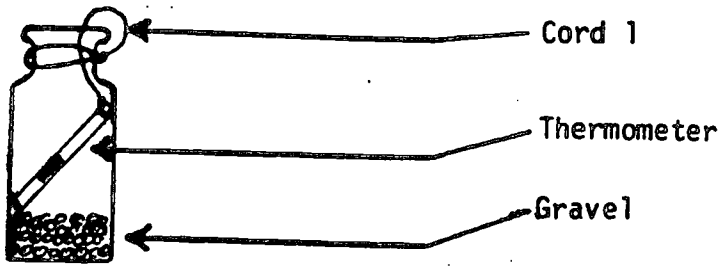
    Illustrate the concept of a thermocline--an area of abrupt temperature change in relation to depth;

    Show that cold water is heavier, i.e., denser, than warm water;

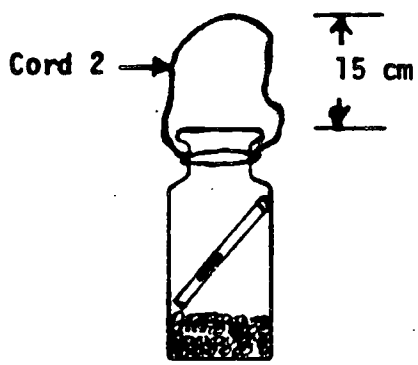
    Practice math skills on data table and graph construction.

Source From Developing Model Marine Education Activities, Oregon Department of Education, Salem, OR, 1979.

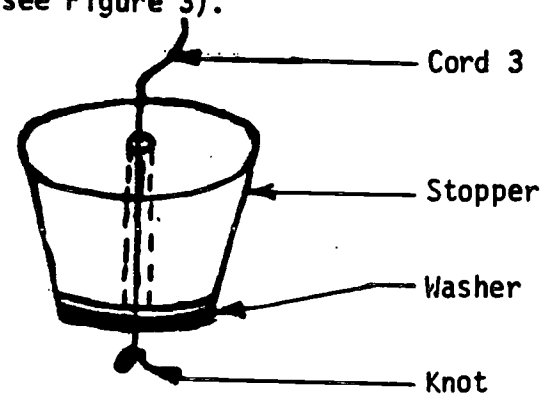
Resources For water thermometers (e.g., #65-2240): Carolina Biological Supply Co., Powell Laboratories Division, Gladstone, OR 97027.



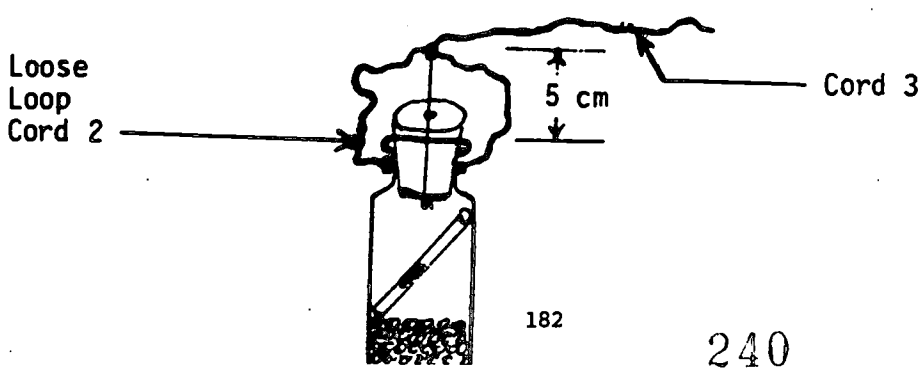
3. Attach a loop of nylon cord (Cord 2) to outside of bottleneck to allow 15 cm or so above stopper to top of loop (see Figure 2).



4. Attach the end of the remaining nylon cord (Cord 3) to the stopper by inserting the cord through the stopper hole (must be a reasonably snug fit) and through the small washer on the bottom of the stopper. Tie a large knot in the cord to prevent cord from going back through washer (see Figure 3).



5. Attach free end of cord from top of stopper to loop of Cord 2, allowing only 5 cm of slack between top of stopper and top of loop (see Figure 4).



All About Fishes

A Study of Fishes

BY
OREGON STATE UNIVERSITY SEA GRANT COLLEGE PROGRAM
OREGON DEPARTMENT OF EDUCATION

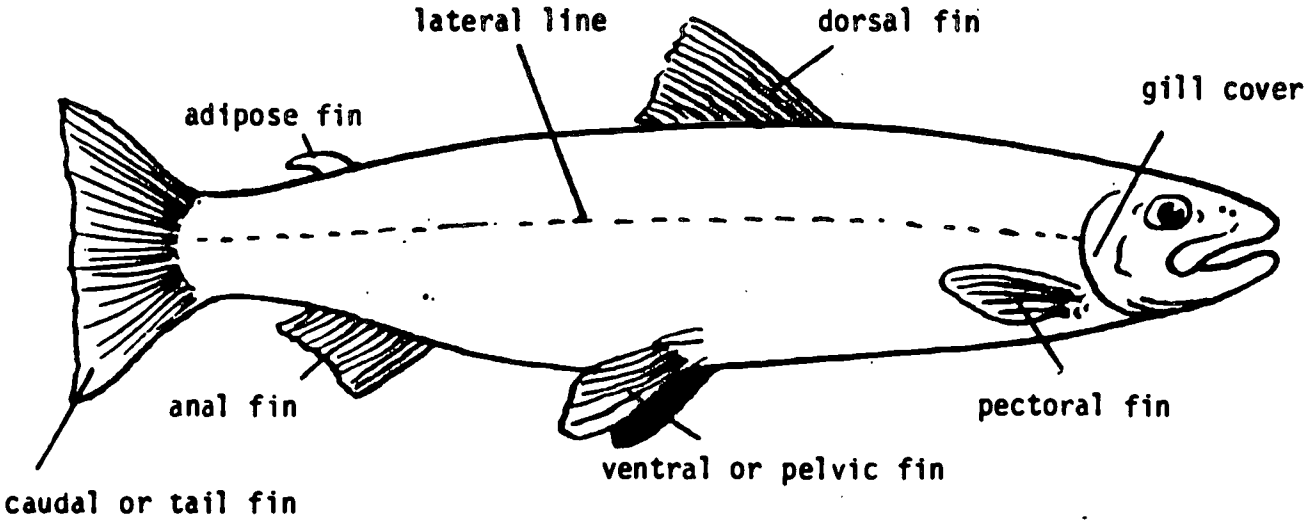
This series of activities can be used as a unit or individually. Or you could assign different groups to each activity and have each one report to the class on their findings.

The course goal is for the students to be able to describe how fish are adapted to their environment, further reinforcing the concept that water environments support life. The time required for this unit varies depending on how many activities you intend to complete. Materials are listed with each activity.

This material from Oregon Wildlife provides an overview of fish external and internal anatomy. It could be used to supplement or prepare for a detailed study of live or prepared specimens. Most biology or vertebrate anatomy texts contain drawings of fish anatomy and morphology and could be used as sources for overheads. You will need to duplicate one article for each student to read.

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AN INTRODUCTION TO FISH

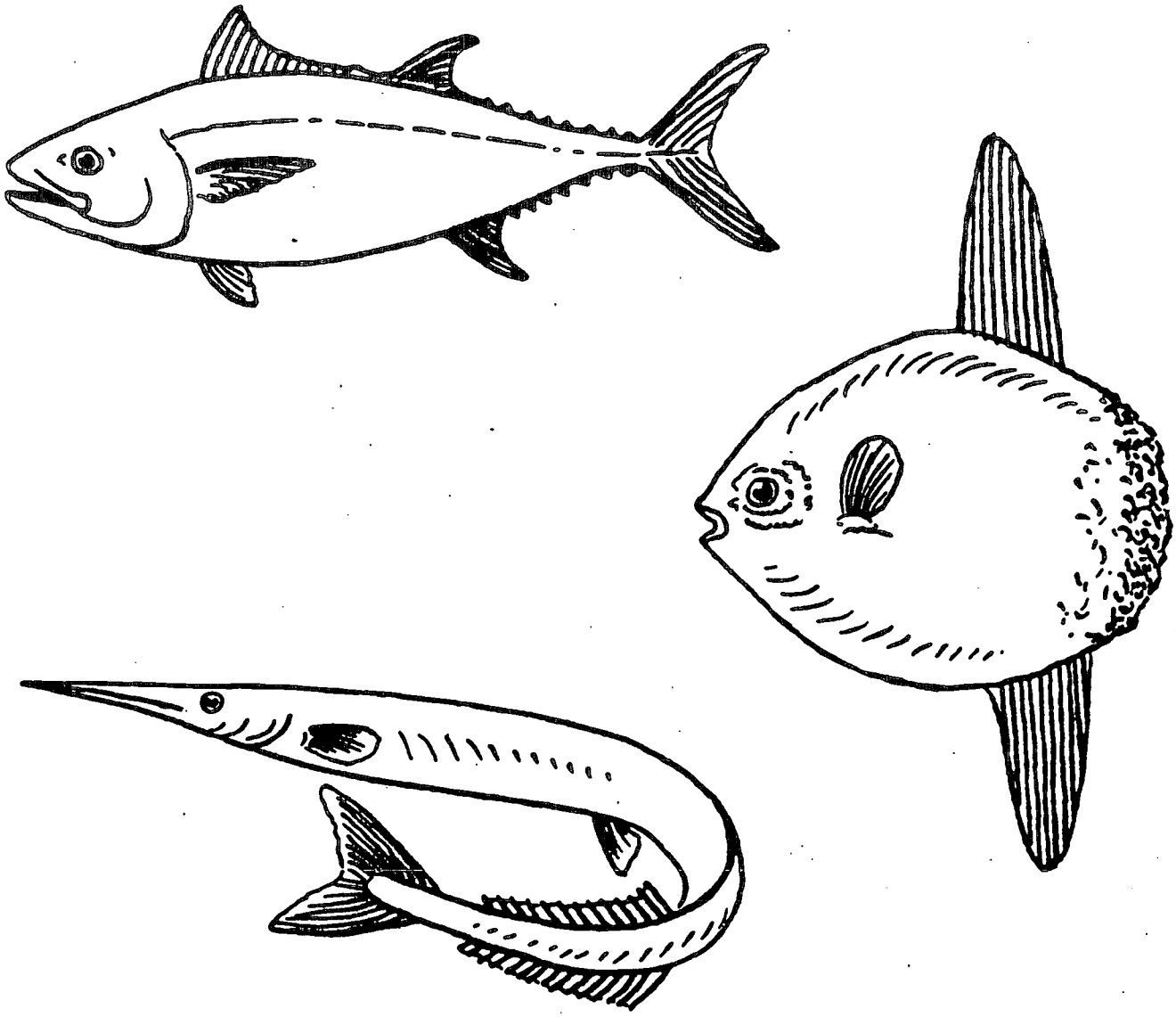


Have you ever watched a fisherman cleaning his day's catch when suddenly he stops and starts poking around with the point of his knife and exclaims, "I wonder what that little gadget is?" Chances are he is looking at some unfamiliar part of the fish's anatomy that has attracted his attention. To some people the anatomy of a fish is interesting. To others it is a slimy mess not to be reckoned with.

The anatomy of a fish can be interesting if one stops and considers what function each part plays in supporting the life of the critter and better adapting him to his particular aquatic habitat. In general the structure of most fishes is quite similar with some exceptions and a wide variety of variations. In spite of the many variations in shape, the basic plan of body organization in fishes is bilateral symmetry as for the vertebrates generally. To simplify matters, the anatomy of a fish will be discussed only as it applies to the freshwater species with which we are more familiar and with an occasional reference to other species.

The ideal form of a fish is torpedo-shaped or fusiform and is designed primarily for speed and quick, rapid movement in water. Of all the fishes in the world, the tuna comes closest to resembling the idea form. From this generalized shape, the forms of many fish depart moderately to completely and range from globe-shaped to thread-like in outline. The majority of our freshwater species like trout and salmon closely resemble the ideal shape while bass, crappie, flounder, and catfish represent more extreme variations.

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The tuna (top) has the most efficient shape for a fish, but nature created a variety of specialized shapes with such extremes as the needle fish (bottom) and the sunfish (middle).

Movement of fish is dependent primarily upon the fins or appendages attached to the body. Powerful sweeps of the caudal or tail fin propel the body forward at lightning speed. Dorsal, pelvic, pectoral, and anal fins are used somewhat for locomotion but serve primarily as stabilizing and maneuvering organs to aid the fish in diving, climbing, banking, turning, and stopping in water. A fatty adipose fin located between the dorsal fin and the caudal fin of salmonids and various species of catfish has no significant use. The fins of fish play an important role in fisheries management. Removal of one or more fins has enabled fisheries managers to secure valuable knowledge on distribution, life

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history, and survival. Marking by this means is common practice in trout and salmon management today.

In some of our so-called warm-water fish such as bass, catfish, crappie, and bluegill, some of the soft rays in the fins have developed into one or more strong sharp spines which are capable of inflicting painful wounds on an unsuspecting individual--hence the common name "spiny rays" is applied to this group of fish. In many catfish, a special gland located at the base of the spine can inject a secretion into a spine wound which creates a stinging paralyzing effect on man. The stout pectoral spines of these fish are often used as defensive weapons.

As in other vertebrates, the skin of a fish is an envelope covering the body and is the first line of defense against disease. It also affords protection from and adjustment to environmental factors that influence life through the sensory receptors found there. Located in the skin are also special cells that give fish their color and make it possible for them to camouflage themselves so well.

Embedded in the skin of most fish are hard bony scales which overlap like shingles on a roof with the free margin directed toward the tail to minimize friction with the water. When examined under magnification, fish scales present a definite pattern of contoured lines which to a trained observer can reveal the age and growth rate of each individual fish. Some fish, like the catfish, are naked in a technical sense in that they have no scales.

Scattered among the skin cells are the mucus glands which secrete the slimy covering and the distinctive odor which are most objectionable to many people. Presumably the mucus covering lessens the drag on a fish as it swims through the water and provides a protective coating over the scales. It also serves in a protective sense in that many a prized catch has escaped from the grasp of a dismayed angler with one quick twist of its slippery body.

Sensory organs in fish are alike in most respects and serve primarily in warning of danger and in detecting food. Two openings found on either side of the snout are the nares or nostrils and represent the organs of smell externally among fish. All fish in general have specialized organs of taste in the

lining of the mouth, lips, pharynx, and on the snout. In addition, some species including the catfish and sturgeon have barbels or whiskers as they are sometimes called. Barbels are weird extensions of the skin, found around the mouth, which contain taste buds to aid these fish often found living in turbid water in locating food organisms.

Have you ever crept up to a good looking fishing hole only to catch a fleeting glimpse of your intended prey as it disappeared from sight and wondered what happened? Chances are, some faint vibrations were telegraphed from your feet through the ground and into the water where they were picked up by the sense organs of the fish and sounded the alarm. Located along the mid-line on either side of the body are single rows of tiny pores extending from the head to the tail. This is the lateral lines system of sense organs found only in fish and the aquatic stages of amphibians. The sense organs are part of the nervous system and are used to pick up vibrations much too low for the human ear to detect.

Most fish see through a pair of lidless eyes that are much like our own though modified for vision under water. Most often the eyes are lateral on the head with partially independent fields of vision and movement. Variations range from the blind cave fish, which have no eyes, to the flounder and other flatfishes that have both eyes on one side of the head.

Hearing and balance, as in higher vertebrates, is centered in the inner ear. In all fish, the outer and middle ear are missing, leaving the inner ear as a specialized part of the lateral line sensory system. A "swim bladder" or "air bladder" is characteristic of true fishes and is found in the body cavity, usually lying over the other organs found there. The air bladder functions as a resenator in sound perception, as a sound producer, as an accessory breathing organ and in weight-regulating. A good example is the air bladder found in catfish.

The skeleton of a fish is a complex combination of external and internal structures having both soft and hard parts. Most easily recognizable is the so-called axial firm skeleton composed of the skull, the vertebral column, the ribs, and the intermuscular bones which give a fish its general shape. The pelvic and pectoral girdles provide firm support for the paired fins. The

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external skeleton is less easily recognized as such by the novice and is composed of scales, fin rays, and connective tissue that toughens the skin and joins it to underlying muscular tissue, bone, and cartilage.

Like most other vertebrates, muscle tissue makes up a good part of the body. Trunk muscles are the most abundant and are attached to the firm skeleton. They are primarily used in movement of the skeletal parts and in locomotion. To the average person these muscles are the "salmon steaks or fillets" which are highly prized as food. Unlike most vertebrate muscle arrangement, the muscle tissue in fish is laid down in a schematic pattern and appears as neat stacks of flakes when the skin is removed. They give a fish considerable strength for its size.

Most fish are dependent upon their aquatic habitat for the life-giving oxygen which they must have to survive. Catfish are an exception and have the ability to absorb oxygen through their skins as well as through their gills, and for this reason, they can survive for several days out of water, provided their bodies are kept cool and moist. To most other fishes the circulatory system consisting of the gills, the heart, and the blood vessels is their sole means of survival. The gills of a fish perform the same function as our lungs. Exchange of certain gaseous waste products for fresh oxygen occurs in the many delicate gill filaments attached to the rear edge of the more ridged gill arches. A set of gills are found on either side of the head in and at the rear of the mouth cavity where water circulation is readily available. A stiff bony gill cover protects these delicate organs from outside damage. Attached to the gills by a short artery is the heart. It is found in the fore-part of the body cavity just below the gullet. The heart, of course, pumps the blood through a tubular network of arteries, veins, and capillaries. A small organ associated with the manufacture and destruction of blood cells, called the spleen is usually found at the rear end of the stomach.

The basic plan of the digestive tract of vertebrates was established among fishes. The organs associated with this system lie in a continuous series, beginning at the mouth and ending at the anal opening just anterior to the anal fin and occupy the greater part of the body cavity. The organs lying in between these two openings are the mouth cavity, the pharynx, the gullet, the stomach,

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the pyloric caeca, and the small and large intestines. The one organ in fish which puzzles most people is the pyloric caeca which is attached to the intestines and lies just behind the liver. The pyloric caeca is a cluster of small finger-like pouches that look very much like a gob of worms at first glance. The caeca has a digestive and/or an absorptive function.

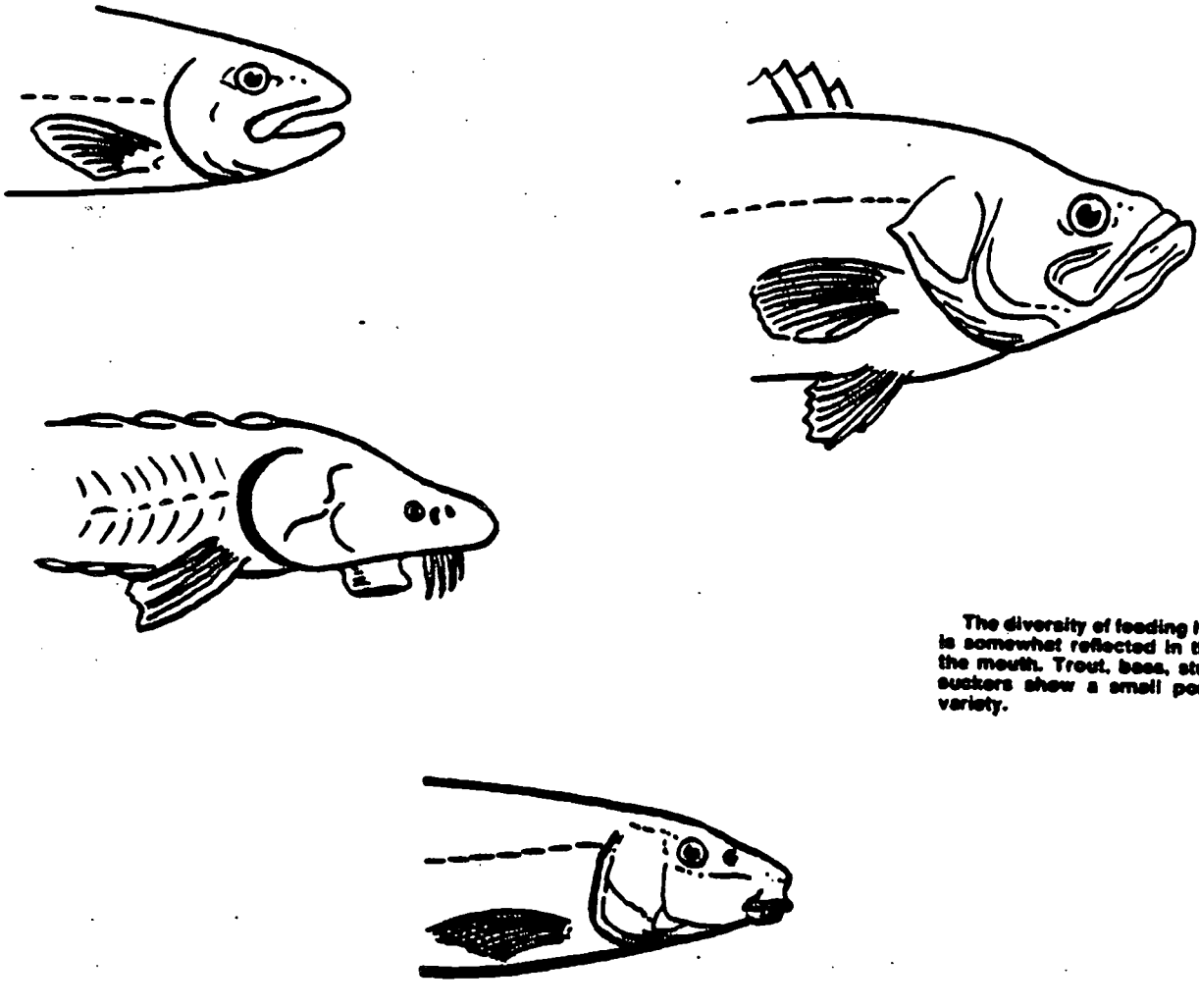
A large maroon-colored organ occupying the front part of the body cavity is the liver, which plays an important role in the digestive process and also acts as a storage place for fats and blood sugar. Another organ closely associated with the liver is the gall bladder which acts as a temporary storage place for liver secretions. Other organs in the digestive tract need little explanation since most are easily recognized.

The kidneys as most people recognize them in mammals are bean-shaped organs attached to the back wall of the body cavity. In fishes, these paired organs take on a different shape and can be recognized as the long, dark reddish-brown pulpy mass lying just below the backbone. Kidneys are richly supplied with blood vessels and are quite bloody when broken in the process of removing when cleaning fish for the table. They function mainly in the elimination of metabolic wastes from the body.

The diversity in feeding habits of fishes is somewhat reflected in the shape of the mouth and the structure of the teeth. A wide variation in mouth structure exists. However, the species with which we are concerned have either terminal or inferior mouths. Predator species such as the bass or pike generally have large terminal mouths, bordered by strong toothed jaws. In bass and catfish, pads of numerous short, fine-pointed teeth lie just inside the lips and are adapted for grasping and holding. Insect feeders generally have smaller mouths and less well developed teeth. Some species, like the squawfish, have bony arches equipped with long pointed teeth, located on either side of the pharynx. These are the pharyngeal teeth which, through muscular action, work in opposition to each other as food is being swallowed. The teeth serve in a holding or a tearing capacity. Pharyngeal teeth in other fishes of the minnow family may be more flattened for grinding purposes.

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Some fish, like the common carp and course-scaled sucker, have inferior mouths with little or no body structure or teeth present. The mouth is designed primarily for a sucking action and indicates these fish are scavengers, which feed mostly on vegetation or other debris.



The diversity of feeding habits of fish is somewhat reflected in the shape of the mouth. Trout, bass, sturgeon, and suckers show a small portion of the variety.

The reproductive process in fishes is known as bisexual reproduction in which sperm and eggs develop in separate individuals. In immature fish, the reproductive organs are oftentimes difficult to locate. Upon reaching maturity, however, there is no question. In trout and salmon the eggs develop in large skeins which crowd the body cavity at maturity. Prior to spawning the tissue holding the egg clusters together ruptures and releases the egg masses in the body cavity. Muscular action forces the eggs out through the ovaduct. The

reproductive organs of the spiny ray fishes are similar; however, in the females the egg sac does not rupture and is located at the rear end of the body cavity. Eggs of these species are generally much smaller in size; consequently, one female fish may produce as many as several million eggs. Although a number of species of fish in the world are live-bearing, all the more common freshwater species are egg bearers.

The anatomy of a fish is much more detailed and complicated than the general discussion presented here. My purpose has been to acquaint one with the more common parts of the anatomy and some of the functions each plays in supporting the life of a fish. Hopefully, it will make one's next encounter with the "slimy critter" a little more intresting.

Suggested Discussion Questions:

1. What determines the shape of a fish?

2. Describe the "skin" of a fish.

3. What organs do fish and humans have in common? What organs are different? Are the functions of the organs in common similar?

4. How are the mouths of fishes adapted to their feeding habits? Give examples.

Source — Adapted from "Anatomy of a Fish" by Larry Bisbee, Oregon Wildlife, April 1974, pp. 3-7, Oregon Department of Fish and Wildlife, Portland, OR 97208.

Part II. Gills: Their Uses and Design

Materials:

- Fish heads
- Dissecting scissors, blade and tweezers
- Petri dishes
- Dissecting scopes or magnifying glasses
- Duplicated diagram of fish gill or overhead

Since most marine fish swim with their mouths open, and since water contains both oxygen and food, fish have structures called gillrakers to protect their gill filaments from clogging particles much as we have a valve to prevent food from clogging our windpipes. In carnivorous fish like bass, gillrakers are knobs on the gill arches, while in filter-feeding fish (herring and menhaden) gillrakers are fine sieves that strain plankton from the water for food.

This is a "dissecting lab" activity emphasizing only the head of fish. You could combine this with a whole fish lab or concentrate on gill structure. You will need to obtain fish heads of two types: a carnivorous fish like trout, mackerel, snapper, bass, perch, or blue rock fish, etc.; and a filter-feeding fish like herring, shad or anchovy (a common estuarine minnow like the silverside). A pair of scissors or dissecting blade plus tweezers will aid in removing the gills. Several gills will come from each fish head. Petri dishes or shallow bowls are needed to "float" the gill so the individual filaments can be observed. Dissection scopes, magnifying glasses will facilitate observations. (Seafood markets, seafood restaurants and local fishermen are good sources for supplies of fish heads.)

Have your students follow the directions below:

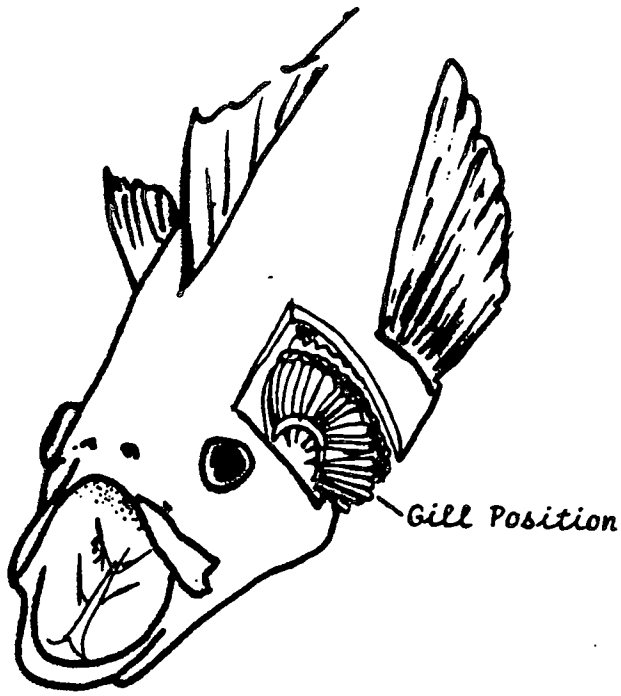
1. Take the gills of the two fish which have been provided by your teacher. Put each in a separate bowl of water. Be sure to label which came from a carnivorous fish and which from a filter-feeding fish.

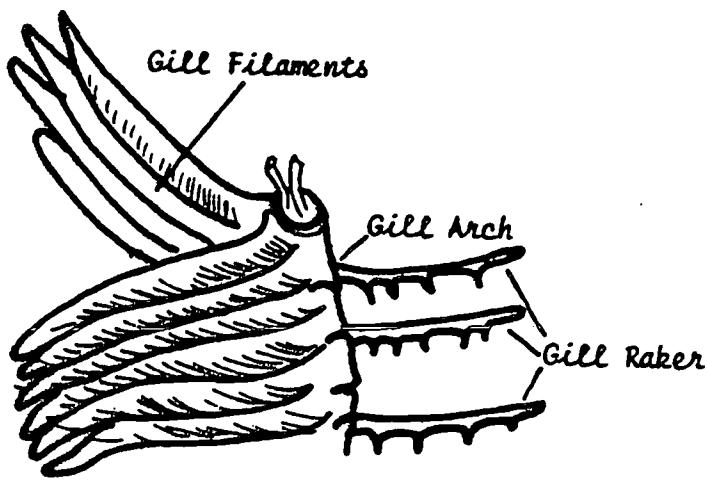
2. Locate the following parts of the gills: gillraker, gill arch, gill filaments. Sketch each of the gills and label the parts. Use the diagram provided by your teacher to help you.

When they have finished their investigation, discuss the function of the gillraker, gill arch, and gill filaments. (Gillraker--to strain particles from water. Gill arch--carries blood vessels to and from filament. Gill filaments--blood vessels close to surface and exchange of O_2 and CO_2 can occur.)

Resources

Adapted from North Carolina Marine Education Manual, Unit Three, Coastal Ecology by Lundie Mauldin and Dirk Frankenberg, Sea Grant Publication UNC-SG-78-14-C, University of North Carolina Sea Grant College Program, North Carolina State University, Raleigh, NC, 1978.


Gill Position


Gill Filaments
Gill Arch
Gill Raker

Part III. Detecting Age and Growth in Fish

Materials:
- Fish
- Tweezers
- Glass slides
- Dissecting or standard microscope

Most fish are born without scales; however, before long all the scales form. As the fish grows, the scales increase in size while the number of scales remains the same. Growth begins at the focus near the center of the scale. As growth proceeds, fine ridges called circuli are laid down in a circular pattern around the focus like the growth rings of a tree. The circuli are widely spaced in warm seasons when growth is rapid and closely spaced in cold seasons when growth in slow. One year's growth is revealed as a series of widely spaced spring and summer circuli followed by a series of closely spaced fall and winter circuli. This pattern is repeated each year. The outer edge of a series of closely spaced circuli, called the annulus, represents the end of growth for that year. The age of the fish is determined by counting the number of annuli (plural for annulus). Often the circuli are so close together that they form dark rings and can be easily counted.

Obtain a fresh fish from the market (or catch your own!) and, if possible, obtain two sizes of the same species in order to compare age and growth. (Very old fish will have scales difficult to interpret as the scales will be thick and opaque.) Tweezers to remove scales (fingers will work), a pair of glass slides (1" x 3"), and a dissecting scope or low magnification microscope (10X to 40X) should be available for each group of students. (Hint: freshwater fish are often better than marine specimens in this exercise.)

Have your students follow the directions below:

1. From the study fish, remove one scale intact using tweezers or your fingers and clean it thoroughly with water. Measure the length of the fish.

2. Wet the scale and place it between two glass slides for examination.

3. Sketch the scale and growth rings, noting any that are heavier or darker in appearance. Count the number of annuli of the scale.



When the students have completed the activity, discuss the following:

1. The rationale for using growth rings on a scale is similar to using growth rings to determine the age of a tree. However, botanists have found that some trees under changes in soil moisture and temperature, can form more than one growth ring in a year. So ring counts do not always reveal true age. What factors could affect the growth rings on fish? (Sickness, temperature, especially abundant or scarce food.)

2. In theory, a fish grows rapidly in summer and slowly in the winter. Why would this pattern occur? (More food in summer.)

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3. Why would it be important to determine the age of a fish? (To avoid taking fish that are too young. In order to insure that there will always be fish to catch, they should not be taken until they have reproduced at least once.)

Variation of this activity: Take a number of the same species of fish which are different sizes (assume size is directly related to age). Measure the length of the fish and diameter of the scale and plot these results on a graph. Interpret the meaning of the graph. Is fish size and age related?

Source(s) Adapted from North Carolina Marine Education Manual, Unit Three, Coastal Ecology by Lundie Mauldin and Dirk Frankenberg, Sea Grant Publication UNC-SG-78-14-C, University of North Carolina Sea Grant College Program, North Carolina State University, Raleigh, NC, 1978.

Some portions from "How Old Are You?" Marine Biology and Oceanography, Grades Nine to Twelve, Part II, by James A. Kolb, Marine Science Project: For Sea, Educational Service District 114, Port Townsend, WA.

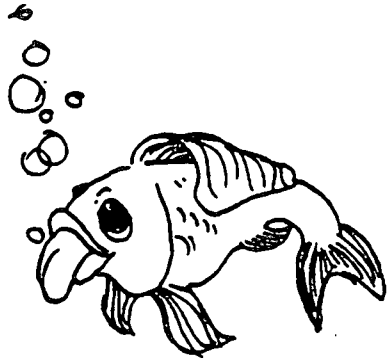
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Part IV. Effects of Temperature on Fish Respiration Rate

Materials:

- Goldfish (small ones work best and are cheaper!)
- Baby food jar with lid (1 per team)
- Cans or beakers (2 per team)
- Hot plate or alcohol burner with stand (USE CAUTION IN THE USE OF EITHER OF THESE)
- Timer or watch
- Dip nets
- Thermometers
- 2 aquariums or fish containers (one for fish to be used and one for "recovery")

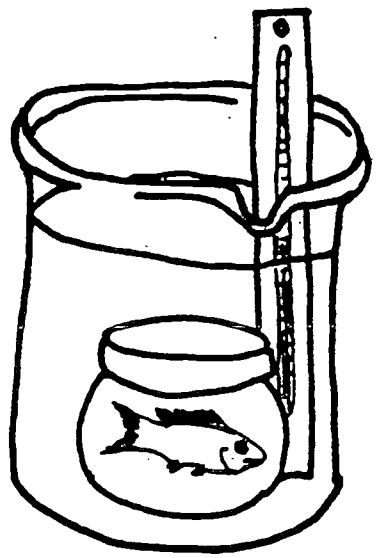
Caution: Remember this experiment is a matter of life or death for the fish: Use only clean glassware, no detergents; watch the temperature and have it no hotter than 35°C.



Have your students carefully do the following:

1. Fill the large containers about half full with tap water. Label them "A" and "B." Fill the baby food jar with water from the fish tank. Using a dip net, add one fish to the jar. Cap the jar and place in in container A.

2. After a minute, record the temperature in container A. Then determine the relative activity of the fish by counting the number of breathing movements (opening and closing of either mouth or gills) that occur in 20 seconds. Repeat this three times and then find the average breathing rate. Record this, and note any other activity of the fish.



3. Heat the water in container B to less than 35°C. Remove it from the heat. Place the jar with the fish in container B. After a minute, record the temperature of container B. Then determine the rate of breathing by counting the opening and closing of the mouth or gills in 20 seconds. Again, repeat this three times and find the average rate. Record this rate and note any change in the activity of the fish.

4. Remove the baby food jar and fish, allow water to cool, then put the fish into the "recovery tank" to rest.

Use the following questions to guide you in a discussion or assign them to the students:

1. How did the breathing rate of the fish in warm water compare to that in the cooler water? (Increase in warmer water.)

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2. Did the fish seem more active in warmer or cooler water? (Warmer)

3. A fish is cold-blooded which means that its body temperature adjusts to the same temperature as its surroundings. A warm-blooded animal is one whose body temperature stays about the same even when the temperature of the surroundings changes. Are you warm or cold-blooded? (Warm blooded)

4. Tropical fish from the Gulf Stream populate the coast in the summer. What do you predict would be the effect of colder, winter water on the fish? How would the fish's activity probably change? (Low temperature water could kill fish or force it to migrate and slow down activity.)

5. Most animals, like fish, have a preferred temperature range in which to live. Some fish are much more sensitive than others to increases in temperature and die if the temperature increases slightly above their preferred range. Discuss why adding heat energy from power plants to rivers, lakes, bays, and streams can present real problems to fish and other animals. (Raises water temperature which can cause water to be too warm or organisms to tolerate and they would die. Abnormally warm water can upset reproductive cycles and affect growth of juveniles and larvae.)

Source — Adapted from North Carolina Marine Education Manual, Unit Three, Coastal Ecology by Lundie Mauldin and Dirk Frankenberg, Sea Grant Publication UNC-SG-78-14-C, University of North Carolina Sea Grant College Program, North Carolina State University, Raleigh, NC, 1978.

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Part V. Dancing Mothballs and Fish Buoyancy

Materials:

- Beaker or jar (1 litre)
- Sodium bicarbonate
- White vinegar
- Mothballs
- Food coloring

Students can investigate how fish can use their gas bladder to maintain or change their position in the water in this activity. In addition, they will be able to observe how gas bubbles can be produced and how they affect the density of objects.

Have the students do the following:

1. Fill the jar half full of water and add a few drops of food coloring, 250 ml of white vinegar, 4-5 mothballs and then, 2-3 grams of sodium bicarbonate.

2. Record the results (at this point, the mothballs will form bubbles on their surface and begin to rise. When they reach the surface, the bubbles will escape into the air and the mothballs will sink.)

Write the following questions on the board or overhead for the students to answer during and after the exercise:

1. What happens on the surface of the mothballs? (Bubbles are formed.)

2. What causes the mothballs to raise? What happens to the overall density as the bubbles cling to the mothball? (The mothballs rise because the overall density of the combinations of mothball and gas bubbles is lowered. This same thing occurs when the fish takes air into its swim bladder.)

3. Why does the mothball sink? (Because bubbles are released into the air when the mothball reaches the surface, increasing the density. This occurs when the fish releases air from its swim bladder.)

4. How does the rising and sinking of mothballs apply to understanding of the fish's air bladder? (When the mothball or fish changes density, it will change its position by rising or sinking in the water column.)

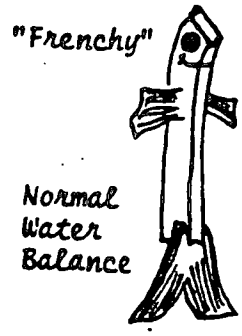
Source: Adapted from North Carolina Marine Education Manual, Unit Three, Coastal Ecology by Lundie Mauldin and Dirk Frankenberg, Sea Grant Publication UNC-SG-78-14-C, University of North Carolina Sea Grant College Program, North Carolina State University, Raleigh, NC, 1978. (Originally from The American Biology Teacher, January 1975, Vol. 37(1):49 by R. Postiglione)

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Part VI. Investigating Osmoregulation--How Fish Cope

Materials: Fresh potato slices
Bowls
Salt

Osmosis is the flow of water through a semipermeable membrane (semipermeable membranes allow only water molecules to pass through) from high to low concentrations of water. Thus, marine fish with body fluids containing higher concentrations of water than the seawater surrounding them constantly lose water through cell membranes. Freshwater fish with body fluid water concentrations lower than lakes or streams will gain water. Both tendencies must be countered to preserve body fluid water balance. A few fish or intervertebrates survive where salinities range both above and below body fluid water concentrations. Most are adapted to only one end of the spectrum and thus are confined to marine or fresh water, and cannot tolerate the variable environment of estuaries.







Marine bony fish (as opposed to cartilaginous fish like sharks) lose water through gills and mouth and would become dehydrated except for adaptations designed to restrict water loss. These adaptations include 1) drinking seawater and excreting salt through the gills to offset the loss; 2) conserving water usually lost as urine by an elaborate kidney system. Freshwater fish on the other hand, do not drink large quantities of water and do excrete copious amounts of dilute urine. When fish enter estuaries, they must be able to adjust their water balance (osmoregulate). Marine fish have this ability to a greater degree than do freshwater fish. The adaptability of marine fish is largely dependent on low permeability of their body surfaces to water (thick scales and mucous membrane) and extraordinary salt regulating activities of gills and kidneys. Most estuarine fish return to the sea for spawning.

Now to investigate how changes in the concentration of water affect the water balance in living cells.

There are several experiments to demonstrate this phenomenon. This one is the easiest. Cut a fresh potato into slices. Place half the slices in a bowl with tap water and the other half in a bowl with salty water. Have the students feel the potatoes at the start and then feel them after 30 minutes or more. The potato slices cannot regulate their water balance and therefore are altered by their environment. This represents what would happen if a freshwater fish were

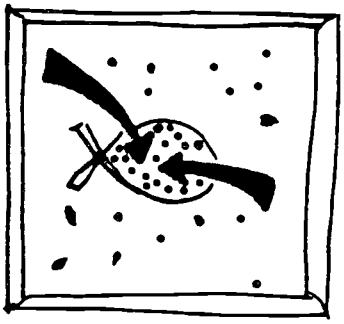
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dropped into the sea or a marine fish dropped into a lake--both would die eventually. Estuarine organisms have mechanisms for maintaining water balance as explained above.

Have your students feel the potato slices in both tap and salt water at the start of the period. Repeat this at the end of the period and record the changes which have occurred. Discuss the following questions with your students:

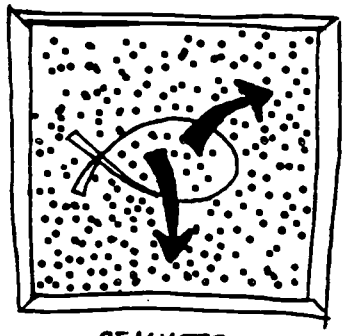
1. What happened to the potato slices left in fresh water? Relate this result to a marine fish being dropped into fresh water, what would happen to it? (Potato slice becomes very stiff, cells have absorbed maximum amount of water. A marine fish would also swell and probably his cells would burst.)

2. What happens to potato slice left in salty water? Relate this result to a fresh water fish dropped into the ocean. (Potato slice becomes limp; cells have lost water and become dehydrated. A fresh water fish would become dehydrated.)



FRESHWATER

High Concentration of Water Outside Cell. Water Flows In. Result: Bloat



SEAWATER

Higher Concentration of Water in Cell. Water Flows Out. Result: Desiccation

Source

Adapted from North Carolina Marine Education Manual, Unit Three, Coastal Ecology, by Lundie Maldin and Dirk Frankenberg, Sea Grant Publication UNC-SG-78-14-C, University of North Carolina Sea Grant College Program, North Carolina State University, Raleigh, NC, 1978.

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Part VII. Schooling Behavior in Fish

Materials:

- Several fish (suitable breeds include: zebra fish, scissor tail, harlequin fish, rosa tetra, tiger barb, pristella, brook stickleback, three-spined stickleback)
- 2 jars with lids
- Dip nets
- Test aquarium (allow aquarium water to "stabilize" for 48 hours before using it)

If possible, it would be helpful to visit a large community aquarium to observe grouping tendencies in fish. This visit will lay the groundwork for the activities below. You could have two groups of students work with one each of the experiments below, then combine results in a class discussion. Have students follow the directions below:

Experiment 1

The tendency of a single fish to school with its own kind.

1. Draw two vertical lines on the aquarium front wall, dividing it into three equal parts.

2. Place equal numbers of the two species of fish in separate screw-top jars, one species per jar. The number of fish will depend on their size; eight to ten 3- 5-cm long fish in a 4-liter jar is adequate (Fig. 1).

3. Place one jar containing a group of fish at each end of the aquarium.

4. Gently place a single fish of one of the two species (call it the Test Fish) in the center of the aquarium. Release the test fish carefully, making sure you do not direct it toward one of the jars at the start of the test. Record the following over a 15-minute period and enter your results:

   a. Time (in minutes) the test fish spends in each of the three areas.

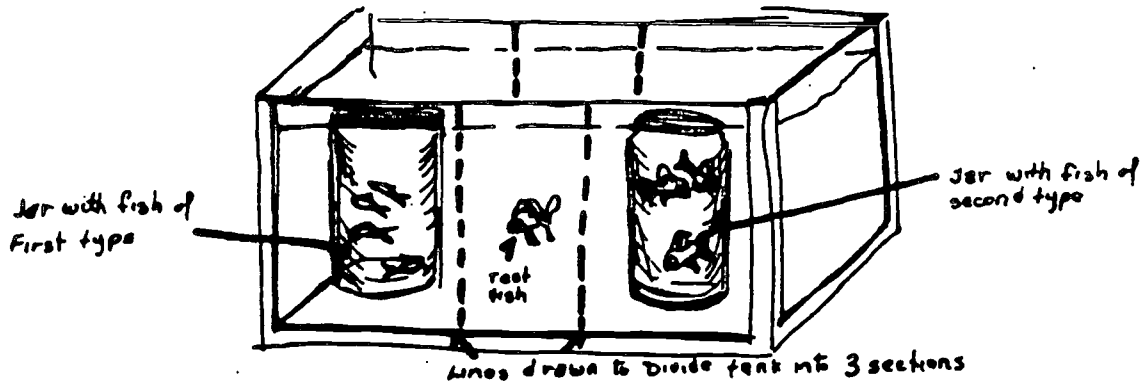
   b. The number of times the test fish moves from one area to another.

5. Remove the test fish, reverse the positions of the jars, replace the test fish, and repeat the recording.

6. Remove the test fish, use one of the other species as a new test fish, and repeat steps 4 and 5.

During the four tests, make qualitative records of the responses of the test fish to fish in the two jars and vice versa.

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Experiment 2

The effect of fish in a group on the behavior of an isolated individual.

1. Select the species that showed the strongest schooling tendencies in Experiment 1. Place the two jars in opposite ends of the aquarium. In one jar put two fish and in the other, six fish, all of the same species (Fig. 2).

2. Carefully release the same type fish in the center of the aquarium. Record for 15 minutes the following data and enter your results in the table.

   a. Time (in minutes) the test fish spends in each of the three areas.

   b. The number of times the test fish moves from one area to another.

3. Remove the test fish, reverse the positions of the jars, replace the test fish, and repeat the recordings.

4. Place equal numbers of fish in each jar, use a different individual as the test fish, and repeat steps 2 and 3.

Again, make qualitative records of responses shown by the test fish and the captive fish towards each other.

Use the following questions to guide students in their investigation or as discussion questions:

1. Did the test fish tend to school more with its own species than with the other species? (Yes)

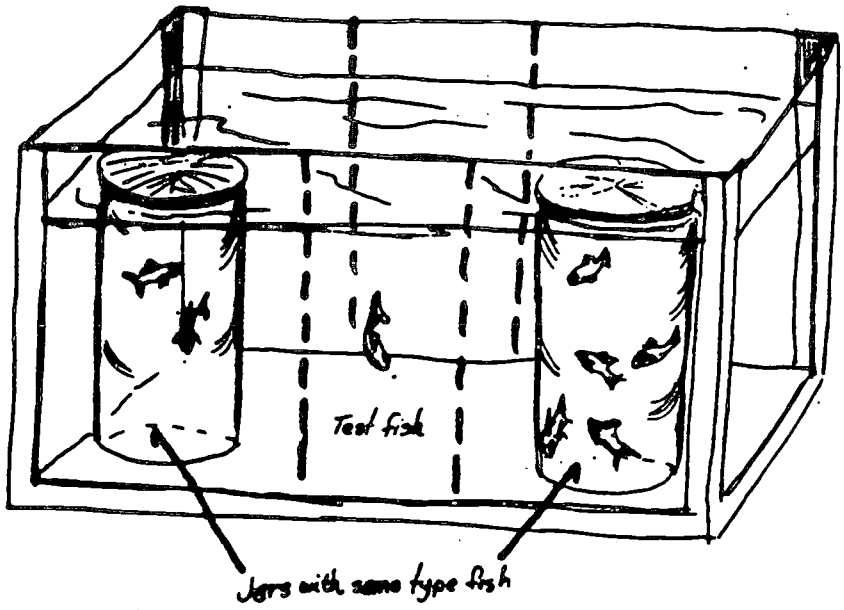
2. Did the test fish tend to school more with the large or with the small schools? (Depends on observations, usually larger schools)

3. In what other ways did the test fish react to the fish in the jars? (Your observations)

4. How did the enclosed fish react to the test fish? (Your observations)

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5. Why do you think fish school? (Protection, feeding, reproduction)



Source

Adapted from North Carolina Marine Education Manual, Unit Three, Coastal Ecology by Lundie Mauldin and Dirk Frankenberg, Sea Grant Publication UNC-SG-78-14-C, University of North Carolina Sea Grant College Program, North Carolina State University, Raleigh, NC, 1978.

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Fish Health is Fish Wealth

Pollution and the Fish Energy Budget

BY
OREGON STATE UNIVERSITY SEA GRANT COLLEGE PROGRAM
OREGON DEPARTMENT OF EDUCATION

In this unit, students will be able to discuss the uses of food energy by fish and what effect pollution can have on growth, health and reproduction of fish.

Present the following situation to the class, using an overhead projector, chalkboard or copy. Allow at least one class period for the activity, and materials needed will be paper and pencils, copies of the worksheet and energy budget.

The amount of energy taken in by a fish cannot all be directed toward growth. Most of the energy fish (or we humans) consume as food goes into maintaining oneself. Because of this, pollution can be very harmful to a population of animals even though it does not kill the animals directly.

When considering the ecology of fish, we must take into consideration the economics of energy. Energy can be correlated with money in that the outflow cannot exceed the income. Bad financial management results in loss of savings or capital and ultimate bankruptcy. For all living things, a loss of stored reserves (fat) is followed by death. Let's consider the inputs and outputs of energy in a fish, and then the impact of pollution.

Work through the energy budget with your students. Discuss energy input and the activities that result in energy loss. Give the students the percentages and let them figure how many kilograms would be needed for each activity and how much would be left over for growth. Or you may want to lead them through the worksheet by giving them more information.

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When they have completed the work sheet for "no pollution" conditions, ask:

1. In what activity did the fish use the greatest amount of energy?
2. What percent of the total energy did this activity require?
3. What would happen if the fish had to use more energy than it got in input?

Now discuss the effects of pollution on the energy budget, giving students the changes due to pollution. When they have completed the work sheet, ask:

1. How did pollution affect the fish?
2. Could sport and commercial fisheries be affected?
3. Could humans be affected in similar ways?

An increase in residential and industrial development, accompanied by an increase in the release of pollutants, usually has some correlation with the reduction or extinction of a population of marine organisms in that area. These environmental insults often take place slowly and without notice. End your discussion by asking your students to think of ways to prevent the release of chemicals known or suspected of being harmful to living things into their local bodies of water.

Source: Adapted from "Fish Energy Budget--Pollution," Wet and Wild, Marine Education Project, Sea Grant College Program, University of Southern California, University Park, Los Angeles, CA.

FISH ENERGY BUDGET

At the beginning of one year, our fish weighed ten (10) kilograms.

Energy Input:	100 kg shrimp (Food for our 10 kg fish)	100 kg
Energy Losses:	72 percent swimming (Swimming energy is used for catching food, avoiding predators, daily migration from home to feeding grounds and back.)	72 kg
	10 percent body maintenance (Body maintenance includes energy for digesting food, maintaining a functioning nervous system, and basic requirements to keep a resting animal alive.)	10 kg
	5 percent health defense and repair (This use of energy includes the losses to parasites, combating disease and healing from abrasion and infections.)	5 kg
	10 percent reproduction (Energy for reproduction may go towards building a nest, production of sperm or eggs, fighting for a mate, and protection of young.)	10 kg
	TOTAL ENERGY LOSS:	97 kg
	ENERGY INPUT:	100 kg
	ENERGY OUTPUT:	97 kg
	ENERGY LEFT OVER FOR GROWTH:	3 kg

Thus, the fish grew from ten to thirteen kilograms during the year of our study.

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EFFECTS OF POLLUTION

		With Pollution	Without Pollution
1.	Pollution is not harmful enough to kill the fish.		
2.	Pollution makes the environment less healthy, requiring the fish to spend an additional 2% of its energy for body maintenance.	12%	10%
3.	Because of the unhealthy environment, the fish must spend an additional 2 percent of its energy to fight the diseases it is now more susceptible to (this is also happening to human beings in cities today).	7%	5%
4.	Pollution is also affecting prey species. The prey are not as healthy and not reproducing effectively, resulting in less food for our fish. This requires a greater expenditure of energy to get enough food for survival. The fish must now expend an additional 5 percent of its energy for swimming.	77%	72%
5.	Because of the above losses, reproduction cannot continue at its past rate without an energy deficit. Consequently, the fish must reduce its reproductive energy requirement to 3 percent.	3%	10%

The economics show that our fish will stay alive in the polluted environment, but that it can grow only one kilogram during that year. But more importantly, it had to reduce its reproductive capacity from 10 percent to 3 percent. This means that slowly there will be fewer and fewer fish. As we see the decline in numbers, we will probably see that fish have more diseases and appear less healthy. To the casual observer, there will be no dramatic fish kills, only a gradual and silent loss of the species.

NET RESULT: 1 kg for growth

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STUDENT WORK SHEET

FISH ACTIVITY	ENERGY USE	
	Without Pollution (in kg of shrimp)	With Pollution (in kg of shrimp)
Swimming		
Body Maintenance		
Health, Defense and Repair		
Reproduction		
TOTAL ENERGY LOSS		
ENERGY INPUT		
ENERGY OUTPUT		
ENERGY LEFT OVER FOR GROWTH		


COTTONWOOD CREEK
NATURE TRAIL

RESOURCES

Following is a list of sources suggested for further reading, activities and extended study. Those marked * are suitable for students; others require teacher direction.

Burt and Grossenheider, A Field Guide to The Mammals. Houghton-Mifflin Co., 1964. *

Carless, Jennifer. Taking Out The Trash. Island Press, 1992.

Carolina Biological Supply Co. For guides and lists of outdoor study equipment, and classroom supplies.
Powell Lab Division, Gladstone, OR 97027

Cornett, James. Wildlife of the Western Mountains. Nature Trails Press, 1982. *

Frankel, Lillian and Godfrey. 101 Best Nature Games and Projects. Gramercy Publishing, 1959. *

Gildart, Robert C. & Jan Wassnik. Montana Wildlife. Montana Magazine, 1982.

Golden Guide, Birds of North America. Western Publishing, 1966 *

Huck, Albert R. and Eugene Decker. Environmental Respect. Safari Club International, 1987. (This is good source of activities related to nature, education, awareness, etc. - all in a curriculum teacher's guide.)

Montana Watercourse, PROJECT WET MONTANA, The Groundwater Adventure, Teacher's Guide and Student Books.
Culbertson Hall, Rm. 335, Montana State University
Bozeman, MT 59717

Murie, Olas J. A Field Guide to Animal Tracks. Peterson, 1974

National Geographic Field Guide To The Birds of North America. revised edition, 1988. *

National Research Council. Restoration of Aquatic Ecosystems. National Academy Press, 1992.

National Science Teachers Association, Earth, The Water Planet. 1987, 1992.

National Wildlife Federation, Educational Servicing (for educational units used in this guidebook)
1412 Sixteenth Street, N.W. Washington, D.C. 20036

Outdoor Ethics - Izaak Walton League of America.
1401 Wilson Blvd., Level B
Arlington VA 22209-2318

Project Learning Tree, American Forestry Institute, Western Assoc. of Fish and Wildlife Agencies, WREEC
Salina Star Rt.,
Boulder COLO 80302

Project Wild, Aquatic WREEC, 1987. For information on workshops
" " Elementary and Project Wild workbooks, write:
Secondary Project WILD P.O. Box 18060
Boulder, CO 80308-8060
or call (303) 444-2390

Udvardy, Miklos D., The Audubon Society Field Guide To North
* American Birds, western region. Chanticleer Press, 1977.

Ulrich, Tom. Birds of The Northern Rockies. Mountain Press Publishing, 1986.
*

Ulrich, Tom. Mammals of The Northern Rockies. Mountain Press
Publishing, 1986. *

Water, Water everywhere. . . Oregon State University Sea Grant College Program.
Corvallis, OR and the Oregon Department of
Education, Salem, OR (for educational units used in this guidebook, nature
trail section)

Wildlife Habitat Conservation Teacher's Pacs, National Institute for Urban
Wildlife, 10921 Trotting Ridge Way
Columbia, Maryland 21044

Yates, Steven. Adopting A Stream. University of Washington
Press, 1991. *

Your Local College or University Bookstore, Public Library Systems
and School Libraries.

Computer Software Packages:

Minnesota Educational Computing Consortium 2520 Broadway Dr,
St. Paul, MN 55113. Request list of of software on wildlife
management.

Nationwide Computer Products, POBox 61, Morrisville, PA 19067
Request software list for environmental sciences.

Yaker Environmental Sysyems, Inc. POBox 18, Stanton, NJ 08885.
Request list for software on environmental topics.

Life on the Range: The Frontier Cattle Era

These activities are suited for classroom prep prior to the ranch visit. Many of these activities can be adapted for use during the site visit. Teachers are encouraged to modify, using all or in part the suggestions below, especially for younger and older students.

Art and Cowboys - Review prints by famous cowboy artists. Discuss in class; assign students a creative writing story on the print or artist of their choice. (Check with museums or libraries for sources of artwork)

Alphabet, Montana Style - a) write a word for each letter of the alphabet that describes a part of Montana history (C=cattle on the open range, S=for Granville Stuart, etc.)

b) write a word for each letter in MONTANA - that has to do with cowboys or the west (O=open range, etc.)

Book Covers and Markers - Make a cover for your history book that tells a story of the old west; out of construction paper, make a book mark with a drawing, symbols or words from Montana's history.

Commercials - each student can write a TV commercial about Montana to get people to visit; use all present and past information that would be interesting to out of state and foreign visitors.

b) have students research magazines, newspapers, listen to radio and watch for TV ads about Montana; what is said or shown to attract people to the state? Report to the class, offer ideas for other information to add, or what NOT to say about Montana.

Clue Game - Teams of 3-4 students can prepare sets of clues about a person or event in Montana history and give them to the 'audience'; start with difficult clues and make them progressively easier to guess. See which team can guess with the fewest clues.

Clue Relay - Pair up the students; hand out to each pair a prepared clue. The clues can relate to cowboys, cattle, western history, pioneer life, etc. When the team writes down what it thinks the clue means, they trade for another teams' clue. The first team that has all the clues and answers wins. (name for a cow that pulls a wagon = an ox, oxen team; protective leg coverings=chaps)

History Debate - Good for older students in sociology classes.
Many topics can be debated, either to the class or in front of other classes, teachers, school board, etc. Topics suggested include: railroad owners wanting to kill bison to clear the way for their trains; moving of Indians to reservations so white settlers could homestead; a rich miner talking to city council about building a smelter next to the river; you are citizens of Helena and (your town) both want to be the new state capitol; cattle ranchers and miners wanting the same land; **IMPORTANT:** all of these should be debated from the historic standpoint; that is the teams should be role-playing historic figures and situations, using only information available back then. Provides excellent opportunity for library orientation, outside research and contacts.

Displays - Make folding, standup or countertop displays about historic Montana people, places, events. Good for open-houses, back to school nights, showcasing student work in history.

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Historic Diary - Have students choose a figure or event in Montana history, and write a diary as if they were that person, or an observer at an event (railroad in Montana territory, Conrad Kohrs introducing a new breed a cattle on the ranch) The diary can be a day, week or month-long effort, and presented in front of the class.

Dioramas - Fun for younger students and a good group activity.
After discussing a particular part of Montanan history, the students can design a display using cardboard boxes, construction paper, clay, glue, crayons, etc. Have the students share their scene with the class, telling who and what is in it. Make labels and place them around the class or school for others to see.

Cowboy Jeopardy - give answers to history or cowboy-related questions; the students need to ask the question. Students could write their own answers and questions to try to stump each other.

Map Activities - a) make a large cardboard Montana shape; students each bring in a magazine clipping that shows some aspect of Montana (forest, copper, rivers, cows, etc.) Glue them in the state shape making a collage.
b) have students map cattle trails, Indian reservations, railroad lines, major rivers, cities and other items that would have been on an 1870, 1880, 1890, 1900 map.

Montana Mobiles - have students bring in clippings of various items related to Montana, past or present. Have them paste these clippings on stiff backing, punch holes in the cards, run string through them and hang from paper clips in the ceiling or walls. Have each student tell what they have in their mobile. Could be done in pairs or teams.

Montana Murals - On a long piece of butcher or wider paper, assign students a part of Montana history to draw about, and have them do so in order on the paper. Can be hung in a hallway, ceiling, wall or classroom windows. You can also give each student a separate piece of paper and tape them together when they're finished.

Montana Pictionary - Each student takes a turn at the chalkboard. The teacher gives students a history/sociology term to draw a picture of on the board, within 30, 20, 10 seconds. Class can have heads on desks, and then look up and raise hands to guess. First right guess is the next quick draw at the board.

History Book Relay - Divide the class into even rows, place a textbook on the first desk in each row. Each student should have a piece of paper and pencil ready. On the board, write an event, date, person in the form of a question (who was, when did, where were, etc.) Write enough questions for each person in the rows. Give a signal to start, and the first person looks up their answer, then writes it down and passes the book back to the next person, etc. The first row finished writing their answers down correctly wins.

Twenty History Questions - Have a student pick a date, event, person in western history, tell the teacher, and keep it to themselves. The rest of the class takes turns asking questions that can only be answered with "yes" or "no". A yes answer gets to ask another question. The student who correctly guesses the object is the next to be questioned by the class.

Story Time - Choose an event, date, person or place in Montana history to write about in a creative story. Put yourself in the story as an observer or active part. Illustrations are optional.

Sights, Sounds, Scenes, Situations - Write a pyramid poem about your favorite one of the above, and illustrate. A pyramid poem starts with one

	WORD	on top
two	WORD WORD	next
three	WORD WORD WORD	next
four	WORD WORD WORD WORD	and so on.

Usually up to five lines is normal.

Example:

WIND
ALWAYS BLOWING
KNOCKS OVER CHAIRS
MAKES THE HOUSE DUSTY
MY MOTHER HATES TO CLEAN!

Montana Mix-up - Make a ditto of dates and events that don't match, pass it out to the class and have them put dates in correct order with events.

Historic Pantomime - Have students take turns acting out silently a character or occupation in Montana history (cowboy, gold miner, woman in covered wagon, making soap, candles, etc.)

Visit Montana - It is 1885 (or any year from 1860-1900), and you are invited to visit relatives in (Miles City, Deer Lodge, Helena, etc.) Describe your visit in terms of what you saw on the way, how long it took to get there, by what means, what was the weather like, time of year, clothing you wore, food you ate, what activities you did, etc. This is a great opportunity for research into a particular year in history. The situation could also be reversed. You are living in a Montana city and are inviting out-of-state relatives to visit. Tell them what they will need, what they will be doing, what to wear, how to get here, etc. Present either scenario to the class.

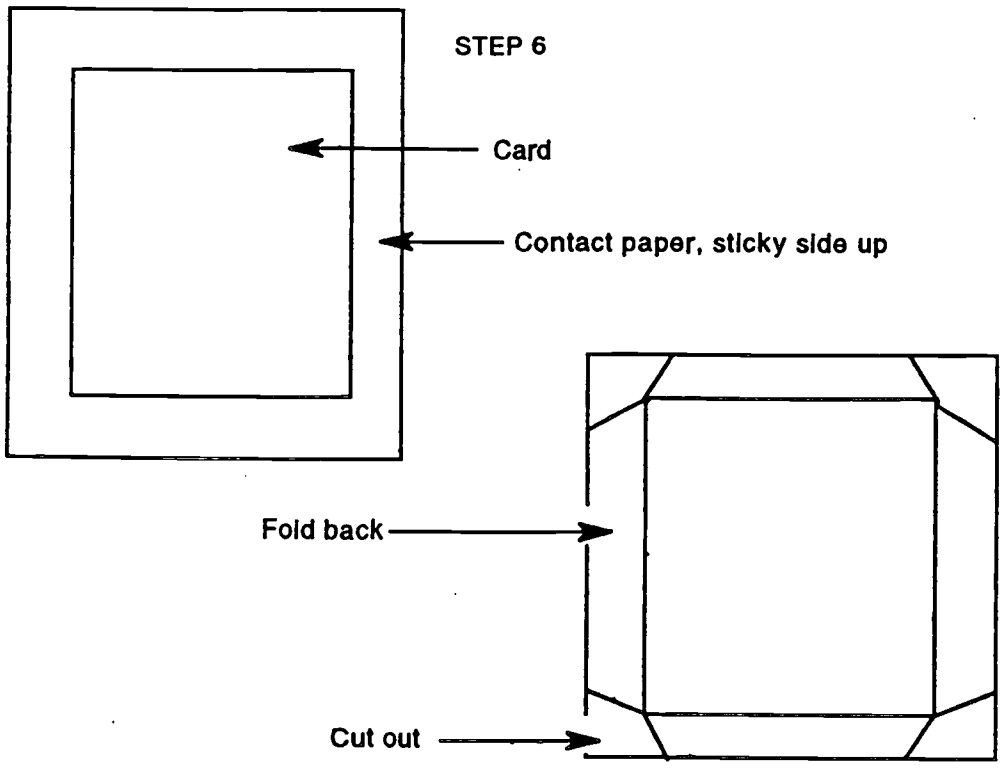
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CONSTRUCTING THE GAMES

The following instructions are a guide for constructing "hardback," more durable versions of the "softback" games provided in the teachers' materials.

Cowboy Bingo

1. Copy pp. 15e-i. of the teachers' guide (the players' cards) onto card stock or another heavy paper. Trim each to 7 1/2 " x 9 1/2 ".
2. Cut 5 pieces of poster board in a contrasting color, each 8" x 10" (or 9" x 11" if you plan to laminate. A larger border is necessary in order to get a good seal.)
3. Glue the players' cards onto the colored pieces of poster board, leaving a 1/4 to 1 inch margin all around.
4. Cover with clear contact paper or laminate. To use clear contact, cut a piece of contact paper larger than the card you wish to cover (at least 4 inches longer and 4 inches wider than the card).
5. Peel the backing off the contact, and place it STICKY SIDE UP, on a flat surface.
6. Carefully place the players' card ILLUSTRATION SIDE DOWN in the center of the contact paper. Turn the card over, and smooth out any air bubbles, working from the center out toward the edges.
7. Trim the corners of the contact paper, and fold the extra length and width over to the back of the card. Smooth out air bubbles.



STEP 7

8. Copy the callers' cards (pp.15a-d in the guide) onto card stock or other heavy paper. (Remember that these cards have two sides--the prices are on the backs.)

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9. Cut the cards apart and laminate or cover with clear contact.
10. Provide game chips or other markers (at least 50) to use with the game.

A mail order source for chips, game pieces and dice is: Creative Publications, 5040 West 111th St., Oak Lawn, IL 60453 (800-624-0822).

The Round-Up Game

1. Copy the game grid (p. 184 of the teachers' guide) onto card stock or other heavy paper.
2. Cut out the grid and the silhouettes of the cowboy and longhorn, and glue them onto a contrasting color of poster board, cut 8" x 8".
3. Cover with clear contact paper ~~(see p.)~~ or laminate.
4. Copy, cut, and cover the game cards ~~(p. of the guide)~~.
5. Copy, cut and cover the diagram ~~(p. guide)~~ which shows players how to set up their pieces.
6. Provide 1 game piece (Cowboy) and 12 markers (Cattle). See above for a mail order source.

The Trail Drive Simulation

1. Copy the two halves of the Trail Drive map ~~(pp. and of the teachers' guide)~~ onto card stock or other heavy paper. Trim the bottom ~~of p.~~ and the top ~~of~~ so that the map fits together exactly. Mount on mat board or on several thicknesses of poster board, glued together.
2. If you want a more colorful map, use colored pencils to color in the game path (hoofprints). Speckled hoofprints should be colored green (to indicate that players should take a Fate Card); dotted hoofprints should be colored blue (for River Crossing Cards). An alternative is to mark the hoofprints with green and blue coding dots, available from office supply stores. Use red dots to mark the Decision Spaces (solid black hoofprints).
   DO NOT USE MAGIC MARKERS on the map because the ink will bleed slightly under the contact paper.
3. Cover the mounted map with clear contact paper. The basic process for doing this is the same as that described for the bingo cards. Because working with larger pieces of contact paper is awkward, however, it is recommended that you cover the map in two sections, with an overlap in the middle.
4. Copy the Fate Cards onto heavy green paper and the River Crossing Cards onto heavy blue paper (or place green and blue dots on the backs of the appropriate cards). Cut apart and laminate or cover with clear contact.
5. Provide 4 game pieces (herd markers) and 4 dice (one die per trail drive team).
6. Be sure teachers have all instructions and master copies of the handouts and record sheets which accompany the simulation. (These are found in the teachers' guide.)

The Western Art Collector Game

1. Copy the game cards (p. of the teachers' guide) onto heavy paper, cut apart and place a small dot on the back of each card. (Stick-on dots are available in office supply stores.) Laminate the cards or cover them with clear contact.
2. Copy the game board (pp.) onto heavy paper and mount EACH SIDE on mat board or on three layers of poster board glued together. The mat board or poster

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Cottonwood Creek Nature Trail

Following are some suggested activities for the nature trail, or any outdoor setting. The sources for these are listed in the Resources of Section 2. Teachers are encouraged to adapt and modify for individual class needs.

Aquatic Ecology - Review Habitat: define and describe, sing song, etc. At a streamside location, have students describe fish habitat. View this by constructing a 'waterscope'. Take a 1/2 gal. milk carton, cut the top off, and a small 'window hole' in the bottom. Wrap plastic wrap over and around the bottom, taping to the sides. Students can look through the top into the water, the carton is waterproof. Have teams describe what they see, report to class. Compare with other parts of the stream, other students reports, or write in a journal. Have older students take water temp at varying depths, collect rocks, debris, soil, etc. from creek and view in trays (cut off bottoms of milk cartons, or anything with a white background). Discuss how different organisms use the same habitat; discuss NICHE, BALANCE, WEB OF LIFE.

Awareness - Along the nature trail, have the group sit in a circle for 1 minute with their eyes closed. Using their ears only, guide them through a hearing hike. Have them listen for all sounds, big, little, nature and human made. Have them either write or draw description of what they heard. This can also be done for other senses: touch, smell, sight. Objects used can be from the trail (please return them where you found them) or item you have brought in a 'grab bag'. (Rocks, pinecones, grass, dirt, leaves, sticks, shells, bark, etc.)

Extension: Have students do this at home, and report finding to class, or draw, write about each sensory experience.

Community Change - For classroom observation, a cow pie serves as a good example a community succession. Obtain several three to five day old cowpies (Grant-Kohrs Ranch has an abundance in the pasture next to the nature trail, be cautious around livestock). Place them in gallon jars with perforated lids. Keep moist by sprinkling every two or three days with water, and maintain warm, sunlit conditions (the smell will pass in a few days). Within a week, organisms will begin to grow. Using a hand lens, ask students to record and estimate numbers of organisms. Succession usually continues up to 10 weeks.

Extension: keep jars in different conditions and record growth in same manner.

Habitat Flash Cards - On 3x5 cards, have students choose a wild animal (discuss wild/domestic difference) and draw its picture, or find photos in magazines and paste them on the cards. On the back of the card, write the 4 parts of the animals' habitat - Food, Water, Shelter, Space and what or where those are. Attach a string through a hole in the top corners of the cards. The card will hang down the back of a student as others try to help him guess what animal he has. The student can ask questions about his animal, but others can answer only with Yes or No. (Does it have fur? Does it eat berries? etc.)

Construct a Habitat - Using the animal flash cards, have students exchange them, and then draw an appropriate habitat on butcher paper. each habitat must have all four parts. Extended the activity by drawing the habitat in all four seasons.

Habitat Mobiles - Have the students, choose a wild animal, find a picture of it in a magazine, and cut it out. Determine what it's habitat is and find pictures or draw them. Paste the cards on construction paper, and make a hanging mobile.

Habitat Song - describe the components of a habitat: Food, Water, Shelter, Space, by teaching young students this song (to the tune of Row Your Boat) and using hand signs to describe the component:

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Signs:
Food - hands on stomach
Water - hand over mouth
Shelter - hands over head
Space - arms in circle in front

Song:
"A (animal) needs a place to live,
That's it's HABITAT;
Food, Water, Shelter, Space
That is where it's AT!"

Inch Hike - Using the ruler in the Discovery Pak, have teams of students along the trail describe what they find next to the ruler. Record where they find it (1", 3 1/4", etc.) Do this in different areas, playground, classroom, trail, yard, home. A variation of this is to use the same teams, and have one gently push aside the soil for one inch, describing what they see on their way down into the earth. Replace any disturbed soil, rocks, etc. on the trail.
Discuss the impacts of human activity on even the smallest creatures and plants, and the differences between a natural and disturbed area.

The following activities are from the Project WILD series of educators workbooks. They are listed here because they fit into the site theme, and can be adapted for most grade levels. Check the Resources for address information.

Project WILD Aquatics Activity Book:

Blue Ribbon Niche	Water Canaries
Fashion a Fish	Water We Eating
Riparian Retreat	Water Words

Project WILD Elementary Book:

Animal Poetry	Grasshopper Gravity	Tracks!
Ants on a Twig	Nature Search	
Color Crazy	Sensory Awareness	

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PROGRAM EVALUATION - "History, Naturally!"

School Name: _____

Teacher Name: _____

Town: _____ State: _____

Date of Visit:_____ Grade Level, # in Class:_____

Curriculum Used:

Life on The Range: The Frontier Cattle Era _____

Cottonwood Creek Nature Trail _____

Reservation System:

How did you find out about this program? _____

_____

Was the reservation system convenient? _____

_____

_____

Program: Please circle your response using the scale below:
1 (high/agree) 2 (medium/average) 3 (low/disagree)

Relevance to your curriculum	1	2	3
Level of presentation	1	2	3
Appropriateness of activities	1	2	3
Methods of presentation	1	2	3
Appropriate for class size	1	2	3

Comments on strengths/weaknesses:_____

_____

_____

_____

Teacher's Guidebook: Please circle your response.

Overall Usefulness	1	2	3
Quality	1	2	3
Interest Level	1	2	3
Age-Appropriate	1	2	3
Accuracy of Information	1	2	3
Background Information	1	2	3

Pre-Visit Activities:

Usefulness	1	2	3
Quality	1	2	3
Age-Appropriate	1	2	3
Interest Level	1	2	3

Please list the activities used (pre-visit or on-site):_____

_____

_____

_____

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How much time were you able to spend preparing for this program?

How much time did you spend on the ranch site conducting activities?

Post-Visit Activities:

Usefulness	1	2	3
Quality	1	2	3
Age-Appropriate	1	2	3
Interest Level	1	2	3

Additional Comments:

Thank you for your input, comments and suggestions on the "History, Naturally!" program. Please complete this form and return with the teacher's guidebook and video to the Visitor Center at the completion of your site visit, or remove this form and mail it to:

Grant-Kohrs Ranch National Historic Site
"History, Naturally!" Program
P.O. Box 790
Deer Lodge, Montana
59722

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Office of Educational Research and Improvement (OERI)
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Educational Resources Information Center (ERIC)

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